July 22, 1998

Note To: Addressees

From: Jim O'Leary

Subject: Background Document and Supporting Information for July 29 State Meeting on Industrial Shop Towels, Wipes and Rags Contaminated with Listed Solvents

Attached for your information are: (1) a draft agenda for our July 29th meeting dealing with listed solvent-contaminated shop towels and wipes; (2) a background document describing current problems with listed solvent-contaminated shop towels and wipes; and (3) a copy of an interim report on this subject that was used to support our decision to move forward with a rule, and as support for the options we are currently evaluating.

At our July 29th meeting, I also will present a briefing that summarizes the above information, and hopefully initiates a dialogue with you on this subject.

I look forward to seeing you on the 29th. Please call me at (703) 308-8827 if you have any questions.

Addressees

Steven E. Frazier, Virginia
Bob Barr, Alabama
Joe Hoover, Arkansas
Carroll Cather, West Virginia
James Paterson, Massachusetts
Tom Judge, Missouri
Nancy Ellefson, Minnesota
Wolf Skacel, New Jersey
Larry Nadler, New York
Mike Redig, Florida
Tom Cusack, Washington
Jim McNamara, Georgia
Deborah McGuire, Nebraska
Barbara Simcoe, ASTSWMO

Meeting Agenda

9:00 am -- Introductions

9:15 am -- Meeting Objectives/Establishment of Meeting Ground Rules

9:30 am -- Problem Overview

-- Review what's broken
-- Findings to date
-- State policies
-- Proposed options

10:30 am -- Break

10:45 am -- Identification and discussion of Key Issues/Questions

-- See list of draft issues/questions identified in Background document

12:00 pm -- Lunch

1:00 pm -- Further discussion of Key Issues/Questions

2:30 pm -- Break

2:45 pm -- Continuation of discussions

4:15 pm -- Break

4:30 pm -- Recapitulation and next steps

Background

This paper presents two options the Agency is evaluating that modify current RCRA Subtitle C regulations affecting industrial shop towels and wipes contaminated with listed solvents. These options are not mutually exclusive and can be used together.

The Current Regulatory Framework

In the simplest of terms, a solid waste is a hazardous waste under RCRA if it is (1) listed under 40 CFR Part 261, subpart D, (2) exhibits one or more of the characteristics of hazardous waste identified in 40 CFR Part 261, subpart C, or (3) it is a mixture of a solid waste that is listed in subpart D solely because it exhibits one or more of the characteristics of hazardous waste identified in subpart C, unless the resultant mixture no longer exhibits any characteristic of hazardous waste identified in subpart C. (See 40 CFR 261.3(a)(2)). Therefore, when a listed solvent is used in conjunction with a disposable wiper or reusable shop towel, that shop towel or wiper is a hazardous waste when it no longer can be used. As such, the "spent" shop towel or wiper must be managed as a hazardous waste because it contains a hazardous waste.

However, because of the site-specific nature of this issue, the current Federal policy with respect to RCRA regulatory status of solvent contaminated shop towels has been to defer resolution of specific questions to the EPA Regions and States. This policy was first articulated in a January 23, 1991 letter from Sylvia K. Lowrance, Director, Office of Solid Waste, to Lance R. Miller, Director of New Jersey's Hazardous Waste Management Division, where she stated:

> We believe that the best course of action is to make a more comprehensive interpretation in this rulemaking context [solvent-contaminated rags and wipers]. However, given our current resource levels and competing high-priority projects, we cannot select a particular target date for the final evaluation of this petition [Kimberley-Clark and Scott Paper]. In the meantime, Regions and States continue to use the current case-by-case approach on this subject.

This policy was reaffirmed in a February 14, 1994 memorandum to the EPA Regional waste management directors from Michael Shapiro, Director, Office of Solid Waste, stating:

> Because there are many applications of wipers, we cannot at this time make any generic statements that all wipers are hazardous waste, or that all are not. A material that is a solid waste is by definition hazardous waste if it either 1) meets one of the listings in 40 CFR Part 261, Subpart D, or 2) exhibits one or more of the characteristics described in 40 CFR Part 261, Subpart C. Because there are no explicit listings for "used wipers" in Part 261, Subpart D, a wiper can only be defined as listed hazardous waste <u>if the wiper either contains listed waste, or is otherwise mixed with hazardous waste.</u> Whether or not a used wiper contains listed hazardous waste, is mixed with hazardous waste, only exhibits a characteristic of hazardous waste, or is not a waste at all, is dependent on site-specific factors; this is not a new policy. As a result, any determinations or interpretations regarding this diverse and variable waste stream should be made by the regulatory agency

(i.e., EPA Region or State) implementing the RCRA program for a particular State. This has been our longstanding policy.

Most States (See Appendix A for discussion of State programs governing these materials) have concluded that disposable wipers contaminated with a listed or characteristically hazardous solvent should be managed as a hazardous waste, while reusable shop towels that are industrially laundered need not be managed as a hazardous waste so long as specified conditions are met. These conditions primarily require that the generator ensure that the shipment of shop towels to the industrial laundry contains no free liquids (as defined by SW-846 Method 9095, Paint Filter Test), and the industrial laundry be permitted by the local POTW. A few States, such as Minnesota and Washington, go one step further and require facilities to extract solvent from reusable shop towels in order to ensure that "no free liquids" are transported off-site, and also to ensure that industrial laundries meet the permit requirements of their local POTW. Industrial laundries also urge their customers to remove solvents from the shop towels prior to being transported off-site in order to meet DOT safety requirements and, in some cases, the permit requirements from the local POTW.

For several years, industry, particularly the disposable wipe industry, has requested and even petitioned EPA to address the issue of whether current federal rules are over-regulating the management of solvent contaminated wipes. More specifically, concern has been expressed that many times only small amounts of solvent are applied to wipe, and by the time the wipe is disposed of, little or no risks to human health and the environment should exist because very small or no amounts of solvent remain on the wipe. However, as described above, these wipes are regulated as a hazardous waste because they contain a listed hazardous solvent constituent.

The feedback that EPA has received on this issue as part of regulatory reform outreach efforts, and from industry representatives in the Printing Common Sense Initiative, further encouraged EPA to address this issue, and determine whether changes are appropriate.

Fundamental Issues of Concern

The fundamental issue of concern is whether or not EPA and the States are regulating disposable wipes and reusable shop towels effectively. This, in turn, leads to the following issues:

-- Do situations exist where we might be over-regulating disposable wipes?

-- Do situations exist where we could improve upon current EPA/State regulations and policies affecting solvent-contaminated shop towels and wipes?

-- What environmental policies does EPA want to pursue that derive better waste management and environmental results for solvent-contaminated industrial shop towels/wipes?

Data Collection and Analysis Methodology

Data were collected and developed primarily through site visits, laboratory experiments, and multi-media risk model screening and were supplemented by reviews of previous studies and discussions with State and industry officials. More specifically,

- We conducted preliminary site visits to identify data we would want to collect to understand the demographics and dynamics of solvent-contaminated industrial shop towels and wipers; we also reviewed previous efforts in this area

- We visited 17 facilities and collected sampling data from 9 of these facilities representing the following industrial sectors: printing, auto body repair, aerospace manufacturing and maintenance, circuit board manufacturing, ship maintenance, and coating and adhesive testing and production

- We supplemented our industry site visit data collection efforts with laboratory testing and experiments in areas associated with solvent removal technology effectiveness, shop towel and wiper absorptivity effectiveness (Paint Filter Test), percolation, Liquid Release Test from landfills, and solvent evaporation under a flume hood, and self-combustion

- We conducted multi-media risk model screening to identify those situations; i.e., type of solvent, number of wipes used daily, amount of solvent used on the wipe, hydro-geological and meteorological conditions, etc that could result in an adverse risk to human health or the environment

- We supplemented the above data, where appropriate, with data provided by industry

- We also contacted State and local officials to better understand whether compliance was a problem for either the management of disposable rags and wipes or reusable shop towels.

Major Findings

- Tremendous variability exists in the use and management practices of industry regarding solvent-contaminated shop towels and wipers. A wide range of industries and a large number of firms, literally hundreds of thousands, use solvents on industrial shop towels and wipers. Facilities visited during this data gathering effort included: printing (both flexographic and screen printing), automobile body repair, aircraft manufacturing and maintenance, circuit board manufacturing, and coating and adhesive testing and production. Other industrial sectors identified with significant solvent and shop towel usage include furniture manufacturing and automobile manufacturing and maintenance. From the 17 facilities visited, and from the 9 sites where data were collected, we determined the following:

- The RCRA regulatory status of facilities visited included small quantity generators (SQG) and large quantity generators (LQG). In some cases, solvent-contaminated shop towels appeared to be the primary basis for a facility being classified as a SQG.

- Reusable shop towels, disposable paper and disposable cloth wipers all were found to be used in the site visits; sometimes firms used both reusable shop towels and disposable wipers in their operations.

- Approximately half the facilities visited reported using their shop towels or wipers more than once before discarding and sending them for off-site management.

- The number of shop towels or wipers used monthly by these facilities ranged from a low of 40 per month to 2000 per month.

- The amount of solvent used per month at sites visited was estimated by facility personnel at 5 gallons to 55 gallons.

- The amount of solvent placed on individual shop towels and wipers varied from very small amounts (a fraction of shop towel/wiper weight) to multiples of shop towel/wiper weight.

- Solvents used at these facilities included the following components: toluene, *iso*-propyl alcohol, methyl ethyl ketone, methanol, methyl *iso*-butyl ketone, ethyl acetate, acetaldehyde, acetone, diacetone alcohol, *n*-butyl alcohol, propyl acetate, ethanol, and *n*-propyl alcohol.

- Shop towels and wipers were managed off-site at hazardous waste treatment (incineration) facilities, fuel blending/burning for energy recovery facilities, and disposal facilities, as well as municipal landfills, industrial landfills and industrial laundries.

- Storage of spent shop towels and wipers occurred in either RCRA-compliant covered storage containers, open containers, porous bags or on shelves.

- Solvent extraction technologies observed included centrifugation, mechanical wringing and a screen-bottom drum. These technologies are used by generators to remove solvent primarily from reusable shop towels (but are also used with disposable wipers) to ensure "no free liquids" are sent off-site to an industrial laundry, as well as to assist industrial laundries in meeting their permit conditions from the local POTW.

- Most of the facilities visited also had State or county air permits.

- Compliance with Federal and State rules and policies appears to be inconsistent. Disposable wipers that should have been managed as a hazardous waste sometimes were found to be managed in the municipal solid waste stream. Similarly, situations were found (or made known) where saturated reusable shop towels should have been wrung out to ensure that they met the "no free liquids" test required by States as a condition of exemption from hazardous waste regulation. Laboratory testing found reusable shop towels to fail the Paint Filter Test when solvent was applied at 2 and 2.5 times the weight of the shop towel-- which many facilities appear to do. Similarly, even if amounts of solvent are applied that are less than the above amount, the effects of percolation can easily cause shop towels in the bottom of a container to be completely saturated and fail the "no free liquids" test. However, we do not know the extent of this situation. A previous OSW study also found similar problems with solvent-contaminated reusable shop towels and disposable wipers.

- Firms using small amounts of solvent on their disposable wipers and small numbers of wipers should not pose an adverse risk to human health and the environment, but other situations could pose a problem. Even with a small sample of facilities, situations were found where very small amounts of solvent were placed on the wiper, and relatively small numbers of wipers were used daily. Most chemicals used by industry in their solvent blends appear to pose potential safety hazards (e.g. flammability) rather than health risks. An Internet search of facility MSDSs found most firms using solvents that would be classified under RCRA as ignitable-only or complex mixtures comprised of solvents that would be either listed or characteristically toxic or ignitable. Most of these facilities also used solvent blends with 2 to 5 components (most of the components being hazardous waste upon discard).

Storage and Disposal - Related Risks

- Results to date indicate that solvent-contaminated shop towels and wipers do **not** pose an air emissions problem when managed in a municipal solid waste landfill (MSWLF), or municipal waste combustor in compliance with New Source Performance Standards or Emission guidelines for existing facilities.

- Many situations probably exist where disposable rags and wipes contaminated with **most** listed solvents could be managed in a municipal solid waste landfill without posing a risk to human health, particularly if some level of removal is achieved. However, several other listed solvent constituents used in conjunction with disposable could pose a problem. Other problems could arise if large amounts of solvent-contaminated wipes and rags are disposed in a landfill by one or more generators.

- Surface water runoffs from a MSWLF or from ground water to a surface water body also do not pose an adverse risk to HH&E

-- However, discharges from industrial laundries, particularly solvents from printer and shop towels, has resulted in the Office of Water proposing effluent guidelines for these facilities.

Other Findings From This Effort

- Solvent removal technology efficiencies vary significantly for different combinations of solvents and shop towels/wipers. As stated above, some facilities voluntarily use solvent removal technologies, while in other cases, a few States require the use of the removal technology as a condition for reusable solvent-contaminated shop towels being exempt from hazardous waste regulation. Findings from our site visits and laboratory experiments include the following ranges:

Technology	%Removal
Screen-bottom drum	4 to 28
Hand wringing	19 to 32
Mechanical wringing	10 to 34
Hand wringing + screen bottom drum	41 to 53
Hand wringing + mechanical wringing	28 to 42
Mechanical wringing + hand wringing	23 to 44
Mechanical wringing + screen bottom	33 to 52
Centrifuging	87 to 94

- The above results occurred using different combinations of solvent and shop towels/wipers/rags at 2 times the dry weight of the material

- We found no self-combustion hazard for the shop towels and wipers tested containing "no free liquids"

- Many disposable wipes pass the Liquid Release Test even when considerable amounts of solvent are applied. Disposable paper wipers were tested using a laboratory protocol designed to evaluate whether or not liquids would be released when subjected to the overburden pressures of a landfill (SW-846 Method 9096, the Liquid Release Test). The test results indicate that, at solvent/wiper ratios consistent with minimal solvent load and/or the application of some removal technologies, solvent-contaminated wipes would not be expected to release liquid under landfill-like conditions of compression. More specifically,

- All except one combination of solvents and disposable wipers passed the Liquid Release Test for a solvent amount applied that equaled 50 percent the weight of the wiper. The one exception (MEK/Workhorse wiper), however, passed when 25 percent by weight of solvent to wiper was tested.

- All but 2 out of 17 tests passed the Liquid Release Test for a solvent amount applied that equaled 100 percent the weight of the wiper.

Overall Conclusions

- Do situations exist where we might be over-regulating disposable wipers?

-- **Yes.** From our site visits, laboratory testing and multi-media risk modelling efforts, we are confident that many situations exist where the use of disposable rags and wipes in conjunction with listed solvents will not pose an adverse risk to HH&E if disposed in a municipal landfill. However, under conservative assumptions, we also are concerned that other situations or scenarios could exist where the use of wipes in conjunction with some listed solvents could cause adverse risks to human health.

- Do situations exist where we could improve upon current EPA/State regulations and policies (or their implementation) affecting solvent-contaminated shop towels and wipers?

-- **Yes.** Again from our site visits, laboratory testing, previous studies, and discussions with State officials, we believe there is a substantial degree of non-compliance with both federal and State rules and policies

--- Hazardous disposable wipers sometimes managed in municipal waste stream
--- Hazardous reusable shop towels being sent off-site with "free liquids", violating condition for exemption by States

- What environmental policies/outcomes does EPA want to pursue that derive better waste management and environmental results for solvent-contaminated industrial shop towels/wipers?

-- improve environmental protection
-- any change must be easy to understand and be practical to implement
-- flexibility is provided in how to achieve compliance
-- minimal, if any, increase in compliance costs; if possible, decrease compliance cost
-- encourage and foster pollution prevention and waste minimization

Regulatory Options Under Evaluation

The purpose of this rulemaking is to modify current federal hazardous waste regulations affecting shop towels, wipes and rags contaminated with listed solvents to: (1) ensure these materials are managed safely; (2) clarify existing regulations and make them user-friendly; and (3) where appropriate, reduce regulatory compliance costs.

In the proposal, the EPA plans to discuss two options for modifying current rules affecting solvent-contaminated shop towels and wipes. One option would be a performance based option; the other primarily a risk-based option. **These options are not mutually exclusive and can be used together.** Both options would exempt these materials from being subject to hazardous waste regulations if specified conditions were met. The primary difference between

these options is by removing a greater amount of listed solvent contained in the industrial shop towels, wipes or rags, the generator reduces the amount of regulatory controls or conditions when the material is sent off-site for subsequent handling and processing.

OPTION 1. Any industrial shop towel, wipe or rag contaminated with a listed solvent is exempt from hazardous waste regulations if , when transferred off-site to a material handling or management facility such as an industrial laundry or municipal waste combustor, the solvent contained on each type of shop towel, wipe or rag is **no greater than** X percent by total weight. **However, if the solvent-contaminated shop towel, wipe or rag is sent to a municipal solid waste landfill (MSWLF), then the amount of solvent contained in these materials cannot exceed an average of Y grams per day.**[12] These materials also would have to be stored on-site in closed containers prior to removing any solvent. **Generators also would have to certify that they meet these performance standards.**

This option focuses on the generator removing a large percentage of listed solvent contained in the shop towel, wipe or rag after the facility operator has completed using the solvent-contaminated material. In other cases, solvent-removal may not be necessary because only minimal amounts were originally applied to the shop towel or wipe. Use a solvent-removal technology such as a centrifuge, mechanical wringer or screen-bottom drum also would not constitute treatment. Instead, use of such processes would constitute a form of waste generation since another hazardous waste; i.e., the free liquid, is being generated. This option would not require additional RCRA controls when the materials were sent off-site for further handling and processing. Instead, we would rely on these handling and processing facilities, such as an industrial laundry or municipal waste combustor being subject to Clean Water Act and Clean Air Act regulations to address any risks from the residues still contained in the shop towel, wipe or rag.

Under this option, compliance would probably require centrifuging (but not necessarily) to achieve the prescribed threshold, or conversely very little use of solvent on the wipe. For example, assume X = 15 percent, and the weight of the wipe = 10 grams. This would mean that at the point of shipment off-site, the average weight of the solvent-contaminated shop towel, wipe or rag could not exceed 11.5 grams [10 + 10(.15) = 11.5]. If the weight of solvent applied to the wipe = 5 grams, then at least 4 grams of solvent would have to be removed to obtain the no greater than 15 percent threshold.

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[1]Realizing that there is much uncertainty surrounding how much solvent-contaminated shop towels, wipes and rags could be sent to a MSWLF, Y will be relatively small, probably between 300 and 500 grams per day.

[2]We also believe this high standard would not result in any "free liquids" being sent off-site.

However, having such small amounts of solvent remaining on each shop towel, wipe or rag would not necessarily mean the absence of a potential adverse risk to human health and the environment in a disposal situation such as a MSWLF, as large numbers of these materials could be used and disposed daily. Therefore, to prevent such a problem from occurring, no more than an average of Y grams of solvent per day contained on the shop towels, wipes or rags could be disposed in a municipal solid waste landfill.

OPTION 2a. Any industrial shop towel, wipe or rag contaminated with a listed-solvent is exempt from hazardous waste regulations if these materials are sent to an industrial laundry subject to Clean Water Act requirements, or a municipal waste combustor (MWC) subject to New Source Performance Standards and Emission Guidelines (See 40 CFR part 60 subparts WWW and Cc), and:

1. These materials are stored in a closed container while at the point of generation, and also during transportation and at the receiving facility prior to entering the handling (industrial laundry or combustion) process, and

2. These materials contain "no free liquids" when shipped off-site.

Option 2b. Any industrial shop towel, wipe or rag contaminated with a listed-solvent is exempt from hazardous waste regulations if these materials are sent to a municipal solid waste landfill and:

1. These materials are stored in a closed container while at the point of generation

2. These materials contain "no free liquids" when shipped off-site.

3. The amount of listed solvent contained in the material does not exceed an average of "Y" grams per day when disposed.

Generators would have to certify they met these provisions.

Note: Failure to meet above conditions could result in these materials becoming a hazardous waste, and the industrial laundry, MWC and MSWLF either requiring a RCRA permit, and/or subject to substantial RCRA penalties.

Under Options 2a and 2b, **"no free liquids" would be achieved, when just prior to the solvent-contaminated shop towels, wipes and rags being transported off-site to an industrial laundry, municipal waste combustor or municipal solid waste landfill, a random sample of these materials selected from any part of the container (particularly the bottom) can be squeezed, hand wrung or pass the Paint Filter Test, such that no liquid solvent is**

released.[3]

Note: Certain listed solvents may be banned under both options from being sent to a industrial laundry, municipal waste combust, or disposal in a MSWLF because, even under conservative assumptions, there may exist the potential for adverse human health and environmental effects.

This option would require additional levels of control over Option 1 because the amount of listed solvent contained in each shop towel, wipe or rag could be substantial. Similarly, the containers used under either option would not necessarily have to be RCRA steel drums. Alternative containers could be used so long as there were no air emissions and the container material did not facilitate a fire hazard. In some respects, this option is similar to what many States have adopted as their policy regarding reusable shop towels sent to an industrial laundry. However, we have expanded management options to include the management of these materials at municipal waste combustors and also established a "conservative" risk-based threshold for small amounts of solvent-contaminated disposable wipes and rags sent to a municipal solid waste landfill. However, there are differences from some of the current State policies.

First, the materials would have to be stored from "cradle to grave" in closed containers, not just on-site when sent off-site to a municipal waste combustor or industrial laundry. Second, the definition of "no free liquids" would be more clearly defined and also more stringent to account for free liquids occurring in the bottom of drums through gravity and pressure. Similarly, EPA would provide additional guidance to the user community and the States if the generator chooses to rely on the use of the Paint Filter Test to verify compliance with the "no free liquids" provision because the above test is not always effective and appropriate.

Other requirements under evaluation include appropriate recordkeeping to certify compliance with the "no greater than" threshold, "Y" grams per day was not exceeded on an average daily basis, and constituents were not sent to a subsequent handling or processing facility if banned. Similarly under Option 2, the Agency is evaluating different types of storage containers, other than a steel drum, to determine what types of containers represent viable alternatives.

Important issues under both options are the value of "X" and "Y." Under the first option, "X" would be low, probably in the 10 to 15 percent. As a result, the amount of solvent remaining on the shop towel, wipe or rag would have to be low such that there was no risk from the disposal and handling of these materials from "cradle to grave." **Similarly, "Y" under both Option 1 and 2b also would have to be low to account for the uncertainties that exist in our**

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[3]This provision also could be applicable to defining when the characteristic is removed in ignitable-only characteristic solvents used in conjunction with industrial shop towels, wipes or rags.

data. (See Appendix B describing results of risk screen modeling efforts.) Variables we must consider include:

1. Number of generators sending their materials to MSWLF
2. Number of wipes used daily
3. Amount of solvent applied to wipe
4. Type of solvent; i.e., constituents applied to wipe
5. Risk coefficient of solvent constituent
6. Extent of evaporation prior to leaving generating facility
7. Hazard quotient; i.e., risk level that derives risk coefficient
8. Risk modeling assumptions: exposure to child only or adult; location and size of landfill; distance from landfill boundaries, etc.

How would generators comply and certify?

Under Option 1, generators would have to maintain records on (1) the types of materials; i.e., shop towels, wipes and rags, used and their associated weight(s), (2) the average number of materials used on a daily basis for each type, (3) the average amount of solvent used on each wipe, (4) how they met "X" and "Y" and (5) what "X" and "Y" were. To meet (2) above, generators could simply examine their inventory of shop towels, wipes or rags periodically between two points in time, calculate a beginning number of materials and remaining number of materials, and divide by the number of working days between the beginning and end estimates to derive an estimate of the average number of shop towels, wipes or rags used on a daily basis. Similarly, a generator could take hourly estimates of shop towels, wipes or rags used periodically and estimate a daily average usage.

For (3) above, most generators appear to use about the same amount of solvent on each shop towel, wipe or rag for a given function or operation. Therefore, a generator would only need to take about 10 to 15 sample points and average the amount of solvent placed on **each** shop or wipe used for different operations at the facility. Simple **and relatively inexpensive (less than $100) portable balances** could be used to perform this calculation. Achieving "X" under (4) above could be achieved any number of ways. A generator need only show or provide proof on the type(s) of solvent-removal technologies employed (if any), and calculate the difference in solvent remaining between first applied and prior to transferring off-site, or after the solvent was removed from the sample of shop towels, wipes or rags. Achieving "Y" could be achieved in a similar manner, but also include the average number of shop towels, wipes or rags used on a daily basis. Certification would be achieved by documenting above information and calculations, particularly in how "X" and "Y" were achieved.

Because most firms operate along production lines, the above efforts could be conducted rather easily and only once to satisfy compliance. However, if the types of materials; i.e. shop towels, wipes or rags changed, or the process for how solvents were used in conjunction with the wipes, or production increased significantly (in the case of

estimating "Y", then the above generation of records would have to be repeated.

Similarly, with respect to Option 2, the important compliance components would involve the generator ensuring (1) "no free liquids" were sent off-site to either a industrial laundry, municipal waste combustor, or municipal solid waste landfill, (2) the materials were stored in closed containers from "cradle (point of generation) to grave (receiving facility)", and (3) records (contractual agreements) were maintained on the name of the facility handling the solvent-contaminated materials. For materials sent off-site to a municipal solid waste landfill, records similar to Option 1 above would have to be maintained to verify certification and show that the estimated average daily amount of solvent contained in the materials that were disposed in the landfill did not exceed "Y."

Complying with the "no free liquids" provision could involve use of a screen-bottom drum, use of a mechanical wringer, or centrifuge or any other non-thermal solvent-removal technology, including hand wringing. Again, use of these technologies would be considered a form of waste generation and not treatment. Similarly, situations could also exist where the amount of solvent used in conjunction with the material was so minimal, that no free liquids would be left in the bottom of the container being sent off-site for subsequent management. However, from our site visits and laboratory experiments, even relatively small amounts of solvent applied to relatively large numbers of shop towels, wipes and rags on a daily basis can create free liquids in the bottom of containers through the forces of gravity.

Changes from Current Federal Program

The options under evaluation would provide **federal** regulatory relief for generators and handlers of both reusable and disposable solvent-contaminated shop towels, wipes and rags -- so long as the above conditions were met. Under both options, because the materials would be exempt from hazardous waste regulation if the prescribed conditions were met, generators would **not** have to "count" their solvent-contaminated shop towels, wipes or rags towards their facility's regulatory determination status; i.e., small quantity generator, large quantity generator or conditionally-exempt small quantity generator. However, any "free liquids" generated to meet the "no free liquids" provision" of either Option would count towards their regulatory determination status. Generators would not need to use a hazardous waste transporter to transport the materials to their handling destination. Solvent-contaminated disposable wipes and rags would not be required to be managed in a hazardous waste treatment, storage or disposal facility -- again, so long as the conditions under either option were met. **However, even if the above conditions were met under Option 1 or 2, these materials also could, if so desired, be sent to a RCRA permitted treatment or disposal facility for incineration, burning for energy recovery or land disposal.**

Changes to Most State Programs

If regulatory relief will be achieved for generators using listed solvents in conjunction with **disposable wipes and rags,** then most States will need to modify their current regulations and policies. As seen, disposables under Options 1 and 2b would only obtain regulatory relief if small amounts of solvent remained on each disposable wipe or rag, and/or fell below a daily threshold that was protective of human health and the environment.

State programs associated with **reusable shop towels** would remain relatively constant. However, under Option 2a, we are proposing these materials be managed in closed containers from "cradle to grave" (stored at the industrial laundry in closed containers until entering the laundry process). Compliance with the "no free liquids" provision also would be strengthened by providing better guidance to both State inspectors and generators and industrial laundries. We also are proposing under Options 1 and 2a that industrial shop towels, wipes and rags contaminated with listed solvents be allowed to be sent to a municipal waste combustor subject to requisite Clean Air Act authorities, and so long as specified conditions are met.

Potential Impacts to Industry

Both options could potentially affect a wide variety of industries, particularly small entities. The small entity category most likely to be affected by this action is small businesses, many of which also are small quantity generators. Municipalities operating solid waste landfills and municipal waste combustors also would be affected by this proposal in terms of being able to accept these materials since they are not classified as hazardous wastes.. The number of businesses impacted and the nature of the impacts is somewhat uncertain at this time. Based upon an examination of EPA's Biennial Reporting System, and information collected or provided by industry, we believe thousands of firms could be affected; i.e., these facilities use solvent-contaminated shop towels and wipes, and they would have to adhere to new guidance on what constitutes "no free liquids" sent off-site. Based on the above information, we currently estimate **that 6,000 generating firms could be directly impacted**; i.e., compliance costs could decrease because they use disposable wipes or rags in conjunction with **listed** solvent-contaminated wipes or rags.

Other generating facilities could see their compliance costs increase because they are out of compliance with State policies; i.e., sending their solvent-contaminated shop towels to an industrial laundry with "free liquids", or out of compliance with both federal and State policies; i.e., solvent-contaminated disposable wipes and rags sent to a municipal solid waste landfill. Stated differently, these facilities would see a decrease in costs from federal rules, but an increase in compliance costs because they failed to properly implement current State (or federal) rules or policies.

As stated above, we are proposing under Option 2a that industrial shop towels, wipes or rags contaminated with listed solvents be stored in closed containers from "cradle to grave."

Currently, many States do not require the transportation and management of these materials in closed containers. Therefore, generators not already transporting these materials in closed containers will see an increase in their operating costs through the purchase or rental of containers. Similarly, industrial laundries also could see an increase in operating costs if they must handle their shop towels in closed containers, or require different types of vehicles to transport these materials. However, we are providing flexibility to both generators and subsequent handling and processing facilities by not requiring these materials be stored in traditional RCRA containers. Similarly, this increase in operating costs could be offset somewhat by decreases in insurance costs as well as increases in worker health and safety.

As presently constructed, we believe both "baseline" options, when compared to the current federal standards, will have either positive or no impacts upon the vast majority of facilities. However, both options will probably result in adverse impacts in certain limited circumstances. More specifically, if a facility is not removing "free liquids", or ensuring that "no free liquids" are being transported off-site to an industrial laundry, then additional burden will be required to address this problem. At this moment, we are uncertain as to the number of facilities that would experience such impacts.

Issues/Questions for Discussion:

1. Do you believe there is a sufficient problem, such that moving forward with a regulatory change is appropriate?

2. Do the options under evaluation make sense? Are they clear, understandable? Will they achieved desired outcomes; i.e., improve compliance, increase environmental protection, reduce regulatory costs, foster pollution prevention?

3. Can we improve upon these options, or are there other options that could achieve desired results more effectively?

4. What additional information and guidance would be necessary to ensure clarity and user-friendliness?

-- Is the definition of "no free liquids" clear?

5. What recordkeeping or testing do we need to ensure compliance, particularly with respect to disposal of wipes and rags in a municipal solid waste landfill, or meeting "X" under Option 1?

6. What special handling requirements, if any, do we want for disposables and reusables managed off-site?

-- Should we require materials managed off-site under Option 2a to be transported in closed containers?

-- Must these containers be steel drums, or can they be of other materials so long as these prevent releases?

-- Should these materials be managed at the receiving facility in closed containers prior to entering the laundry or combustion process?

-- Should we also require the same for disposable wipes and rags sent to a MSWLF?

-- Should we require special labeling on the containers sent off-site?

7. Based on your understanding of the risk modeling work conducted to date; particularly the assumptions, should"Y" remain low; i.e. 300 to 500 grams per day (or 9 to 15 kilograms per month per facility) to account for the uncertainty in our data, or can it be increased above these levels? Should "Y" be lower? If so, why?

Appendix A

Summary of State Policies Governing Solvent-Contaminated Shop Towels and Wipers

A review of state policies regarding the regulation of solvent-contaminated shop towels and wipers indicates that most states have similar management requirements in place. The majority of states have developed their own policies (pending EPA action). However, a few states have deferred regulatory decisions regarding the management of solvent-contaminated shop towels and wipers to their respective EPA Regional office. Currently, all states regulate wipers as a hazardous waste when they are contaminated with a listed solvent or exhibit a hazardous waste characteristic and the wipers are destined for disposal. Forty-six states provide regulatory relief for contaminated shop towels that are sent to an industrial laundry and subsequently reused. The remaining four states (AR, ID, SD, and WV) regulate reusable towels/wipers as hazardous waste if they contain a listed hazarous waste or exhibit a hazardous waste characteristic regardless of whether the towels/wipers are being laundered.

The majority of state programs consider laundering to be a form of recycling and subsequently exempt reusable shop towels from RCRA regulation, based on the state agency's interpretation of the definition of solid waste. Other states provide a conditional exemption from the hazardous waste regulations for laundered shop towels. In either case, the contaminated shop towels only are exempt from regulation if the following criteria are met:

- The towels/wipers contain "no free liquids;" and
- The industrial laundry discharges to a Publicly Owned Treatment Works (POTW) or is permitted by the Clean Water Act.

States have different policies on what constitutes "no free liquids." However, the majority of states stipulate the Paint Filter Test (SW-846 Method 9095) for such determinations. Other specified methods include the Liquids Release Test (SW-846 Method 9096), the TCLP (SW-846 Method 1311), and wringing (either physical or mechanical) to meet "no drip" criteria. Only a few states identified wringing to achieve the "no free liquids" standard as a form of "treatment" and it is unclear as to whether any state regulates this activity as regulated treatment. Several state programs specify that obtaining the "no free liquids" standard through evaporation or intentional drying is not allowed.

An overwhelming majority of states require generators to send reusable shop towels only to an industrial laundry facility that is either permitted by a POTW or is subject to and in compliance with CWA requirements. In all cases, the burden of determining whether a contaminated towel/wiper should be managed as a hazardous waste is placed on the generator. However, some state programs specifically state that launderers have an obligation to accept only contaminated towels/wipers that meet specified criteria, otherwise the laundry will be considered a regulated disposal facility. Some states allow on-site laundering of towels/wipers by generators, provided that there is an agreement on file with the state that allows the facility to

discharge to the sanitary sewer. Although, the majority of states discouraged on-site laundering. In addition, at least three states require contractual agreements between generators and launderers for the generator to qualify for an exemption from RCRA regulation.

While the majority of state policies are the same, there are some states with notable variations including:

- **Hawaii** - Wipers must be managed as hazardous waste up until the point at which they are laundered.
- **New Mexico** - Industrial laundries are subject to permitting requirements unless the wipers are place directly into the laundry process (i.e., within 24 hours).
- **Idaho** - Shop towels and wipers are managed as hazardous waste if they are contaminated with a listed waste or exhibit a characteristic. Reusable towels/wipers cannot be laundered unless they are treated to meet the specified LDR treatment standard for the wastes with which they are contaminated.
- **South Dakota** - If a listed solvent is applied to a part and then wiped off with a rag, the rag is considered to be listed (because the solvent is "spent") and must me managed as a hazardous waste and cannot be laundered. If the rag exhibits a characteristic it is a regulated hazardous waste and cannot be laundered. If the rag is contaminated with a listed solvent that was applied directly to the rag, the rag is not considered to meet the listing description and can be laundered without being managed as a hazardous waste.

Table 1 below provides a general overview of current state programs regarding the regulatory status of solvent-contaminated shop towels and wipers. Table 2 provides more specific information on a subset of state programs governing the management of solvent-contaminated shop towels and wipers.

Table 1: State Policies on Reusable Shop Towels/Wipers

State	Reusable Wipers Non-Hazardous If Water Washed Or Dry-Cleaned	Disposable Wipers Considered Hazardous (Qualified)	Why Reusable Wipers Non-Hazardous	
			Not a Solid Waste	Exempt Waste
Alabama	Yes		Yes	
Alaska**	Yes	Yes		Yes
Arizona	Yes	Yes*	Yes	
Arkansas	No	Yes	No	
California	Yes	Yes		Yes
Colorado	Yes	Yes		Yes
Connecticut	Yes	Yes		Yes
Delaware	Yes	Yes		Yes
Florida	Yes	Yes	Yes	
Georgia	Yes	Yes	Yes	
Hawaii	Yes*	Yes		Yes
Idaho	No	Yes	No	No
Illinois	Yes	Yes	Yes	
Indiana	Yes	Yes*	Yes	
Iowa**	Yes	Yes	Yes	
Kansas	Yes	Yes*		Yes
Kentucky	Yes	Yes		Yes
Louisiana	Yes	Yes	Yes	
Maine	Yes			Yes
Maryland	Yes	Yes	Yes	
Massachusetts	Yes	Yes		Yes
Michigan	Yes	Yes		Yes
Minnesota	Yes*	Yes*		Yes

Table 1: State Policies on Reusable Shop Towels/Wipers (cont.)

State	Reusable Wipers Non-Hazardous If Water Washed Or Dry-Cleaned	Disposable Wipers Considered Hazardous (Qualified)	Why Reusable Wipers Non-Hazardous	
			Not a Solid Waste	Exempt Waste
Mississippi	Yes		Yes	
Missouri	Yes	Yes	Yes	
Montana	Yes	Yes		Yes
Nebraska	Yes	Yes		Yes
Nevada	Yes*	Yes		Yes
New Hampshire	Yes*			Yes
New Jersey	Yes*	Yes		Yes
New Mexico	Yes*	Yes*		Yes
New York	Yes*	Yes*	Yes	
North Carolina	Yes	Yes	Yes	
North Dakota	Yes	Yes*	Yes	
Ohio	Yes	Yes	Yes	
Oklahoma	Yes	Yes*	Yes	
Oregon	Yes*	Yes		Yes
Pennsylvania	Yes*	Yes		Yes
Rhode Island	Yes*	Yes		Yes
South Carolina	Yes*	Yes	Yes	
South Dakota	No	Yes	No	No
Tennessee**	Yes	Yes	Yes	
Texas	Yes	Yes	Yes	
Utah	Yes	Yes		
Vermont	Yes	Yes		Yes
Virginia	Yes	Yes*	Yes	

Table 1: State Policies on Reusable Shop Towels/Wipers (cont.)

State	Reusable Wipers Non-Hazardous If Water Washed Or Dry-Cleaned	Disposable Wipers Considered Hazardous (Qualified)	Why Reusable Wipers Non-Hazardous	
			Not a Solid Waste	Exempt Waste
Washington	Yes	Yes		Yes
West Virginia	No	Yes	No	No
Wisconsin	Yes	Yes	Yes	
Wyoming**	Yes	Yes	Yes	

*Note: Refer to individual state policies for qualifications.
**Note: Refer to Regional policies for qualifications.

Table 2: Summary of Participating State Programs

State	Description of Policy
Alabama	Contaminated wipes bound for laundering ad reuse are considered products in use and are not solid wastes, and, therefore not hazardous wastes. The state position is based upon the policy stated by Region IV.
Arkansas	Reusable wipers that contain a listed waste, are mixed with a listed waste, or exhibit a characteristic are regulated as hazardous waste.
Florida	Reusable wipers that are laundered at facilities which discharge to a POTW or are subject to the CWA are not solid wastes and are not regulated under RCRA. Florida also bases their policy on the Region IV position.
Georgia	Laundered wipers are not regulated because they are being recycled and used as effective substitutes for new products according to 40 CFR §261.2(e). Generator storage prior to laundering is subject to the same accumulation requirements as hazardous waste (§262.34).
Massachusetts	Provides a conditional exemption from regulation for non-saturated, solvent-contaminated wipes. The exemption allows for wipes to be sent to laundries without a manifest provided they meet the specified criteria. The "one drop method" is used to determine what is non-saturated (i.e. a wiper is considered saturated if a drop of solvent can be wrung out of it). Saturated wipes must be managed as hazardous waste until they meet the "one drop method".
Minnesota	Disposable rags must be wrung of all free liquids and managed as hazardous if appropriate. Reusable wipes must be wrung to remove free liquids and managed as hazardous waste on-site. If the wipes are sent to an industrial launderer, the shipment does not require a manifest and the laundry does not need to be permitted under RCRA.
Missouri	Contaminated rags used in cleaning and degreasing operations are not regulated as solid or hazardous wastes when laundered. Rags used to clean up spills are regulated as hazardous waste if they contain a listed waste or exhibit a characteristic and laundering may be considered improper treatment. Contaminated rags that are destined for disposal must be managed as hazardous wastes if appropriate.

Table 2: Summary of Participating State Programs (cont.)

State	Description of Policy
Nebraska	Wipers used for cleaning that are contaminated with listed or characteristic solvents are not regulated as hazardous waste provided the wipers are being laundered (recycled) and there is no free solvent present in the wipers at the time they are sent for recycling.
New Jersey	Solvent contaminated rags which are sent for disposal will be regulated according to the mixture rule and have different standards depending on how the rag came into contact with the solvent and the type of solvent used. If a hazardous contaminated rag is being laundered it is not regulated as hazardous waste provided there are no free liquids. Any storage at generator facilities prior to laundering is regulated in the same manner as hazardous wastes.
New York	Contaminated wipes are not hazardous wastes when sent to industrial laundries provided they are not saturated (i.e., pass the Paint Filter Test). Prior to laundering, all wipes must me managed in accordance with specified accumulation standards. Generators must also file a one-time notice under LDR when sending wipers to be laundered.
Virginia	Contaminated rags that are intended for disposal are regulated as hazardous wastes. Hazardous wipers sent to launderers are not regulated as solid or hazardous wastes provided there are no free liquids.
Washington	Hazardous wipes are not regulated as hazardous waste if they are managed according to the established best management practices (i.e., no free liquids, closed container, permitted laundry facility, etc.). Hazardous rags that are sent for disposal are subject to regulation.
West Virginia	Wipes contaminated with a listed hazardous waste or that exhibit a characteristic are subject to regulation as solid wastes. Rags are viewed as spent materials and as such are solid wastes when reclaimed.

Appendix B

Results of Risk Screen Modeling

Background

In order to better understand the risks from disposing of solvent-contaminated wipes in an **unlined** municipal solid waste landfill, a two partition (air/ground water) risk screen computer model was used to estimate the risk coefficients for listed solvent constituents under different scenarios. The models used were EPA's Industrial Source Complex Short-Term /version 3 (ISCST3) for addressing air inhalation risks and EPA's Composite Model for Leachate Migration with transformation products (EPACMTP) for addressing ingestion esposure risks. Both models have been peer reviewed and used extensively by EPA in developing regulations. One thing different in this analysis, however, was the partitioning of the solvent constituents between air and ground water to account for landfill cover after 24 hours.

Because there are literally an infinite number of scenarios, we chose several basic scenarios to bound potential risks. These scenarios included 2 size landfills (small and central tendency), 2 locations (wet and central tendency), 2 types of exposure risks (child and adult), and two types of generators (small quantity generator (SQG) and large quantity generator(LQG)). The different size landfills were derived from data obtained from several states, and augmented with previous data collection efforts on landfill size. Location data came from previous efforts. For a central tendency location, Lincoln, Nebraska was chosen. For a wet location, Houston, Texas was chosen. We also assumed ground water exposure occurred 25 feet from the facility boundary and air exposure 50 meters from the facility boundary. We also assumed that all of the solvent remaining after 24 hours would seep into the ground water.

A key parameter that had to be addressed was estimating how many wipes were used daily and how much solvent was applied to each wipe. These data were derived by examining industry data provided to us; i.e., number of firms using listed solvent and estimates of how many wipes were used annually. We then did some basic calculations to derive an estimate of how mnay wipes, on average, would be used by a "typical" small quantity generator and "typical" large quantity generator on a daily basis realizing that no two facilities are the same in terms of the types of solvent used, the number and types of shop towels, wipes and rags used and the amount of solvent applied to each wipe. For a SQG, we estimated that a"typical" facility would use 30 wipes per day, that a Kimberley-Clark Workhorse wipe would be used (the most common wipe used by induustry in conjunction with solvents), and that each wipe would have 10.4 grams of solvent applied, or 1 times the weight of the wipe. For a "typical" LQG, we assumed that 120 wipes/day would be used with the same amount of solvent on each wipe as an SQG.

A summary of results derived from running the models assuming the above assumptions is found in Table 1. These results represent the risk coefficients derived for the most liberal (low end) and conservative (high end) of scenarios. The low end scenario represents solvent being disposed daily by 1 SQG in a central tendency landfill located in average conditions; i.e.,

Lincoln, Nebraska. The high end scenario represents solvent being disposed daily by 1 LQG in a small landfill located in wet conditions; i.e., Houston, Texas.

These risks coefficients, in turn, can be used to calculate how many facilities could dispose of listed solvent constituents without posing an unacceptable risks; i.e., exceeding a Hazard Quotient of 1. For ground water, these results are found in the next to last column.This is accomplished by dividing the risk coefficient for a particular constituent into 1. For instance, if we divide the low end risk coefficient from ground water exposure for nitrobenzene (.1) into 1, we can estimate that only 10 "typical" SQG facilities would be allowed to dispose of 312 grams of solvent daily before posing an unacceptable risk. Similarly, no "typical" LQG facility would be allowed to dispose of their nitrobenzene. As you can see, some constituents would pose considerable risk, while others would not pose a risk at all.

Finally, we tried to estimate the potential number of facilities that could dispose of their listed solvent waste in a municipal solid waste landfill. We currently estimate that only 6,000 facilities, primarily SQGs wuld be affected by this rule. Similarly, we estimate there are 2,500 MSWLFs nationally. On average, this derives estimates of 3 facilities potentially disposing in a MSWLF, with a maximum of 27 facilities disposing of their listed solvent waste in a MSWLF.

Using the 27 facility estimate, and comparing this figure to the results in the next to last column, we are then able to determine if a potential adverse risk would occur. The last column summarizes this exercise, with a (-) representing a potential problem, and a (+) not posing a potential problem.

Because of the way the model has been structured, alternative risk coefficients can easily be derived. For instance, if we reduce in half the amount of solvent an SQG would dispose of, then the coefficient would be reduced in half. For instance, reducing the amount of nitrobenzene disposed daily from 312 grams to 156 grams use by a SQG facility would derive a low end risk coefficient of .05, or .2 if the amount of solvent used was doubled from 312 to 624 grams per day.

Solving for "X"

Another analysis we performed involved solving for the amount of solvent that could be disposed safely without exceeding a HQ of 1.Table 2 presents the equations used to solve for "X" and also to solve for "R" when we know the amount of solvent being disposed of in a landfill. Table 3 presents the results of applying these equations for particular solvent constituents and for different numbers of facilities sending their waste to the same MSWLF. The far right column represents the amount of solvent for a particular constituent that could be disposed before exceeding a HQ of 1. Similarly, the next to last column estimates the risk coefficient for the same scenario, with any coefficient greater than 1 posing a problem.

Table 1

Bounding of Results

Constituent	Low end Coefficient (GW)	High end Coefficient (GW)	Low end Coefficient (Air)	High end Coefficient (Air)	No. Facilities to reach HQ of 1 **GW** (low/high)	Above/below baseline assumptions
Non-Carcinogens(HQ)						
nitrobenzene	.1	7	.00003	.0001	10/0	-/-
pyridine	.2	7	.00003	.0001	5/0	-/-
ethyl ether	.01	.3	N/A	N/A	100/3	+/-
acetone	.01	.3	.00000007	.0000002	100/3	+/-
methanol	.002	.07	.00000007	.0000002	500/14	+/-
butanol	.001	.04	N/A	N/A	1000/25	+/-
carbon disulfide	.003	.07	.00001	.00004	333/14	+/-
MEK	.0005	.02	.000001	.000005	2000/50	+/+
Cresol-o/p	.0005/.001	.02/.03	N/A//N/A	N/A//N/A	2000/1000//50/33	+/+
MIK	.001	.03	.000009	.00003	1000/33	+/+
cyclohexanone	.001	.03	N/A	N/A	1000/33	+/+
ethoxyethanol-2	.004	.1	.0000002	.0000006	250/10	+/-
tetrachloroeythene	.001	.04	.00001	.00005	1000/25	+/-
isobutyl alcohol	.0004	.02	N/A	N/A	2500/50	+/+

cresol-m	.0002	.007	N/A	N/A	5000/140	+/+
chlorobenzene	.0003	.01	.00005	.0002	3333/100	+/+
ethyl acetate	.0002	.007	N/A	N/A	5000/140	+/+
trichlorofluoromethane	.00005	.002	.00001	.00004	20000/500	+/+
o-xylene	.00002	.0007	N/A	N/A	50000/1400	+/+
dichlorobenzene	.00002	.0007	.0000004	.000001	50000/1400	+/+
ethylbenzene	.00001	.0003	.0000006	.000002	100000/3333	+/+
m-xylene	.00001	.0004	N/A	N/A	100000/2500	+/+
toluene	.00002	.0007	.000004	.00001	50000/1400	+/+
trichloro 1,2,2	.000001	.00002	.0000003	.000001	1m/50000	+/+
xylenes (total)	.000001	.00003	N/A	N/A	1m/33333	+/+
Carcinogens						
methylene chloride	1.1E-07	3.5E-06	3E-10	1E-09		
trichloroethane 1,1,2	4.3E-07	1.3E-05	3E-09	1E-08		
carbon tetrachloride	1.7E-07	5.0E-06	8E-09	4E-08		
benzene	4.1E-08	1.3E-06	3E-09	1E-08		
Other Non-Carcinogens						
trichloroethane 1,1,1	.0001	.003	.000005	.00002	10000/333	+/+
nitropropane	N/A	N/A	8E-07	4E-06		

WHAT IS "X" WITH RESPECT TO OPTION 2?

$X = NLF * CL * RS / (RR * (NLQG * rLQG + NSQG)$

where:

X = the amount of solvent contained in wipes that can be disposed in a landfill by a generator without exceeding a risk threshold or hazard quotient of 1

NLF = number of landfills in region (assumed 1)
CL = constituent loading, or the quantity of solvent disposed with wiper by generators (assumed to be 1.26kg/facility/day for LQGs)
RS = acceptable hazard quotient risk from a single constituent (HQ=1)
RR = reference risk for the constituent of concern (.3 for acetone)
NLQG = number of large quantity generators in the region (assume 0 to 81)
rLQG = ratio of the quantity of solvent disposed by LQGs relative to SQGs (assumed to be 4 in example)
NSQG = number of small quantity generators in the region (0 to 81)

What is risk (R) when solvent generation is assumed?

$R = RR * (NLQG * SLQG + NSQG * SSQG) / (NLF * CL)$

where:

R = the risk from disposing of a known amount of solvent contained in wipes
SLQG = quantity of solvent disposed in wipes by large quantity generators (assumed to be 1.26 kg/facility/day)
SSQG = quantity of solvent disposed in wipes by small quantity generators (assumed to be .315 kg/facility/day)

Preliminary Calculations for Risks from Disposal of Solvent Containing Rags
Assumptions: Case 1 (one solvent primarily used), only LQGs or SQGs)

Case No.	Solvent	RTI Unit Risk	# LQGs	# SQGs	Risk, as HQ	X: Solvent Quantity, kg/fac-d
1	Acetone	0.3	27	0	8.02	
2	Acetone	0.3	0	27	2.01	0.16
3	Acetone	0.3	54	0	16.05	
4	Acetone	0.3	0	54	4.01	0.08
5	Acetone	0.3	81	0	24.07	
6	Acetone	0.3	0	81	6.02	0.05
7	MIBK	0.04	27	0	1.07	
8	MIBK	0.04	0	27	0.27	1.17
9	MIBK	0.04	54	0	2.14	
10	MIBK	0.04	0	54	0.53	0.58
11	MIBK	0.04	81	0	3.21	
12	MIBK	0.04	0	81	0.80	0.39
13	Toluene	0.001	27	0	0.03	
14	Toluene	0.001	0	27	0.01	46.67
15	Toluene	0.001	54	0	0.05	
16	Toluene	0.001	0	54	0.01	23.33
17	Toluene	0.001	81	0	0.08	
18	Toluene	0.001	0	81	0.02	15.56
19	o-Xylene	0.001	27	0	0.03	
20	o-Xylene	0.001	0	27	0.01	46.67
21	o-Xylene	0.001	54	0	0.05	
22	o-Xylene	0.001	0	54	0.01	23.33
23	o-Xylene	0.001	81	0	0.08	
24	o-Xylene	0.001	0	81	0.02	15.56

Constants:

RTI Solvent Loading (kg/lf-d)	1.26
Solvent Quantity, SQG (kg/fac-d)	0.312
Solvent Quantity, LQG (kg/fac-d)	1.248
Number of landfills	1

USE AND MANAGEMENT PRACTICES OF SOLVENT- CONTAMINATED INDUSTRIAL SHOP TOWELS AND WIPERS

INTERIM REPORT

DECEMBER 23, 1997

Executive Summary

Introduction

This report presents the results of an Agency data gathering effort to better understand the use and management practices of solvent-contaminated industrial shop towels and wipers[1]. At issue is whether the current regulatory framework for solvent-contaminated industrial shop towels and wipers should be maintained, or changed to address problems found during this data gathering effort. Any changes proposed would strive to improve the current regulatory framework in terms of (1) protecting human health and the environment, (2) reducing the complexity of a generator's decision-making process with respect to the management of these materials, and (3) fostering pollution prevention where possible.

The data gathering effort described in this report is not meant to comprehensively characterize industry use and management practices for solvent-contaminated industrial shop towels and wipers. Rather this effort is intended to provide a "snapshot" of common industry practices regarding the use and management of solvent-contaminated shop towels and wipers. Because of the wide diversity of industry practices and the multiplicity of factors involved, a comprehensive characterization would be cost-prohibitive and unnecessary for determining the next steps in the Agency's process for potentially reconsidering the regulatory status of industrial shop towels and wipers.

The Current Regulatory Framework

In the simplest of terms, a solid waste is a hazardous waste under RCRA if it is (1) listed under 40 CFR Part 261, subpart D, (2) exhibits one or more of the characteristics of hazardous waste identified in 40 CFR Part 261, subpart C, or (3) it is a mixture of a solid waste that is listed in subpart D solely because it exhibits one or more of the characteristics of hazardous waste identified in subpart C, unless the resultant mixture no longer exhibits any characteristic of hazardous waste identified in subpart C. (See 40 CFR 261.3(a)(2)). Therefore, when a listed solvent is used in conjunction with a disposable wiper or reusable shop towel, that shop towel or wiper is a hazardous waste when it no longer can be used. As such, the "spent" shop towel or wiper must be managed as a hazardous waste because it contains a hazardous waste.

However, because of the site-specific nature of this issue, the current Federal policy with respect to RCRA regulatory status of solvent contaminated shop towels has been to defer resolution of specific questions to the EPA Regions and States. This policy was first articulated in a January 23, 1991 letter from Sylvia K. Lowrance, Director, Office of Solid Waste, to Lance

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[1]For purposes of this study, shop towels are associated with materials that are sent to an industrial laundry for processing and reuse, and wipers and rags are associated with disposable materials.

R. Miller, Director of New Jersey's Hazardous Waste Management Division, where she stated:

> We believe that the best course of action is to make a more comprehensive interpretation in this rulemaking context [solvent-contaminated rags and wipers]. However, given our current resource levels and competing high-priority projects, we cannot select a particular target date for the final evaluation of this petition [Kimberley-Clark and Scott Paper]. In the meantime, Regions and States continue to use the current case-by-case approach on this subject.

This policy was reaffirmed in a February 14, 1994 memorandum to the EPA Regional waste management directors from Michael Shapiro, Director, Office of Solid Waste, stating:

> Because there are many applications of wipers, we cannot at this time make any generic statements that all wipers are hazardous waste, or that all are not. A material that is a solid waste is by definition hazardous waste if it either 1) meets one of the listings in 40 CFR Part 261, Subpart D, or 2) exhibits one or more of the characteristics described in 40 CFR Part 261, Subpart C. Because there are no explicit listings for "used wipers" in Part 261, Subpart D, a wiper can only be defined as listed hazardous waste <u>if the wiper either contains listed waste, or is otherwise mixed with hazardous waste.</u> Whether or not a used wiper contains listed hazardous waste, is mixed with hazardous waste, only exhibits a characteristic of hazardous waste, or is not a waste at all, is dependent on site-specific factors; this is not a new policy. As a result, any determinations or interpretations regarding this diverse and variable waste stream should be made by the regulatory agency (i.e., EPA Region or State) implementing the RCRA program for a particular State. This has been our longstanding policy.

Most States have concluded that <u>disposable</u> wipers contaminated with a listed or characteristically hazardous solvent should be managed as a hazardous waste, while <u>reusable</u> shop towels that are industrially laundered need <u>not</u> be managed as a hazardous waste so long as specified conditions are met. These conditions primarily require that the generator ensure that the shipment of shop towels to the industrial laundry contains no free liquids (as defined by SW-846 Method 9095, Paint Filter Test), and the industrial laundry be permitted by the local POTW. A few States, such as Minnesota and Washington, go one step further and require facilities to extract solvent from reusable shop towels in order to ensure that "no free liquids" are transported off-site, and also to ensure that industrial laundries meet the permit requirements of their local POTW. Industrial laundries also urge their customers to remove solvents from the shop towels prior to being transported off-site in order to meet DOT safety requirements and, in some cases, the permit requirements from the local POTW.

For several years, industry, particularly the disposable wiper industry, has requested and even petitioned EPA to address the issue of whether current federal policy was over-regulating the management of solvent contaminated wipers. More specifically, concern has been expressed that many times only small amounts of solvent are applied to wipers, and by the time the wiper is

disposed of, little or no risks to human health and the environment should exist because very small or no amounts of solvent remain on the wiper. However, as described above, these wipers are regulated as a hazardous waste because they contain a listed hazardous solvent constituent.

The feedback that EPA has received on this issue as part of regulatory reform outreach efforts, and from industry representatives in the Printing Common Sense Initiative, has further encouraged EPA to address this issue, and determine whether changes are appropriate.

Study Objectives

The objectives of this study have been to collect and analyze data on the use and management practices of solvent-contaminated industrial shop towels and wipers in order to (1) respond more effectively to the disposable wiper manufacturers' concerns that instances may exist where the management of solvent-contaminated disposable wipers does not pose an adverse risk to human health and the environment, and (2) better understand the implications of State policies on the use and management of reusable shop towels. From this effort, EPA will determine whether the current regulatory framework for solvent-contaminated industrial shop towels and wipers should be maintained or modified, or whether additional data are still necessary to further understand and clarify this issue.

To achieve the above objectives, this effort has consisted of:

1) collecting data from a small sample of industrial facilities on their solvent and shop towel/wiper use and management practices, including:

- types and amount of solvent applied to the shop towel
- types and numbers of shop towels used by the facility
- how the shop towel was managed on-site after usage
- how the shop towel was managed off-site
- the amount of solvent remaining on the shop towel immediately after usage and 18-24 hours after usage
- whether any removal technologies were used to extract solvent from the shop towel and to estimate the efficiency of that removal technology

2) analyzing other available data provided by industry

3) augmenting industry site-visit data with laboratory-generated data, including:

- efficiencies of solvent removal technologies
- at what level of solvent contamination did a shop towel/wiper generate "free liquids"
- how shop towel/wiper storage effected the amount of solvent remaining on the towel/wiper

4) qualitatively evaluating the chronic toxicity of solvents used by industry based upon a review of available literature.

Overall Study Findings

There are three major findings from this data gathering effort.

First, tremendous variability exists in the use and management practices of industry regarding solvent-contaminated shop towels and wipers. A wide range of industries and a large number of firms, literally hundreds of thousands, use solvents on industrial shop towels and wipers. Facilities visited during this data gathering effort included: printing (both flexographic and screen printing), automobile body repair, aircraft manufacturing and maintenance, circuit board manufacturing, and coating and adhesive testing and production. Other industrial sectors identified with significant solvent and shop towel usage include furniture manufacturing and automobile manufacturing and maintenance. From the 17 facilities visited, and from the 9 sites where data were collected, we determined the following:

- The RCRA regulatory status of facilities visited included small quantity generators (SQG) and large quantity generators (LQG). In some cases, solvent-contaminated shop towels appeared to be the primary basis for a facility being classified as a SQG.

- Reusable shop towels, disposable paper and disposable cloth wipers all were found to be used in the site visits; sometimes firms used both reusable shop towels and disposable wipers in their operations.

- Approximately half the facilities visited reported using their shop towels or wipers more than once before discarding and sending them for off-site management.

- The number of shop towels or wipers used monthly by these facilities ranged from a low of 40 per month to 2000 per month.

- The amount of solvent used per month at sites visited was estimated by facility personnel at 5 gallons to 55 gallons.

- The amount of solvent placed on individual shop towels and wipers varied from very small amounts (a fraction of shop towel/wiper weight) to multiples of shop towel/wiper weight.

- Solvents used at these facilities included the following components: toluene, *iso*-propyl alcohol, methyl ethyl ketone, methanol, methyl *iso*-butyl ketone, ethyl acetate, acetaldehyde, acetone, diacetone alcohol, *n*-butyl alcohol, propyl acetate,

ethanol, and *n*-propyl alcohol.

- Shop towels and wipers were managed off-site at hazardous waste treatment (incineration) facilities, fuel blending/burning for energy recovery facilities, and disposal facilities, as well as municipal landfills, industrial landfills and industrial laundries.

- Storage of spent shop towels and wipers occurred in either RCRA-compliant covered storage containers, open containers, porous bags or on shelves.

- Solvent extraction technologies observed included centrifugation, mechanical wringing and a screen-bottom drum. These technologies are used by generators to remove solvent primarily from reusable shop towels (but are also used with disposable wipers) to ensure "no free liquids" are sent off-site to an industrial laundry, as well as to assist industrial laundries in meeting their permit conditions from the local POTW.

- Most of the facilities visited also had State or county air permits.

Second, compliance with Federal and State rules and policies appears to be inconsistent. Disposable wipers that should have been managed as a hazardous waste sometimes were found to be managed in the municipal solid waste stream. Similarly, situations were found (or made known) where saturated reusable shop towels should have been wrung out to ensure that they met the "no free liquids" test required by States as a condition of exemption from hazardous waste regulation. Laboratory testing found reusable shop towels to fail the Paint Filter Test when solvent was applied at 2 and 2.5 times the weight of the shop towel-- which many facilities appear to do. Similarly, even if amounts of solvent are applied that are less than the above amount, the effects of percolation can easily cause shop towels in the bottom of a container to be completely saturated and fail the "no free liquids" test. However, we do not know the extent of this situation. A previous OSW study also found similar problems with solvent-contaminated reusable shop towels and disposable wipers.

Third, firms using small amounts of solvent on their disposable wipers and small numbers of wipers probably do not pose an adverse risk to human health and the environment, but EPA would like to conduct some additional risk analyses to confirm the specific chemicals and amounts of no concern-- from both an ignitability and a toxicity standpoint. Even with a small sample of facilities, situations were found where very small amounts of solvent were placed on the wiper, and relatively small numbers of wipers were used daily. Most chemicals used by industry in their solvent blends appear to pose potential safety hazards (e.g. flammability) rather than health risks. An Internet search of facility MSDSs found most firms using solvents that would be classified under RCRA as ignitable-only or complex mixtures comprised of solvents that would be either listed or characteristically toxic or ignitable. Most of these facilities also used solvent blends with 2 to 5 components (most of the components being

hazardous waste upon discard).

Other Findings From This Effort

Solvent removal technology efficiencies vary significantly for different combinations of solvents and shop towels/wipers. As stated above, some facilities voluntarily use solvent removal technologies, while in other cases, a few States require the use of the removal technology as a condition for reusable solvent-contaminated shop towels being exempt from hazardous waste regulation. Of the technologies investigated (both in a laboratory setting and through the site visits):

- Centrifugation is very efficient, with removal efficiencies ranging from 47 percent to 87 percent.

- The mean removal efficiency for mechanical wringing ranged from approximately 13 percent to 30 percent for reusable shop towels and disposable paper wipers when the amount of solvent applied was at 2 times the weight of the shop towel/wiper. The mean removal efficiency for disposable cloth wipers ranged between 11 and 56 percent. The mean removal efficiency ranged from 7.5 to almost 19 percent at 0.5 times the weight of the wiper/shop towel.

- The mean hand wringing solvent removal efficiency ranged from approximately 5 to 24 percent for reusable shop towels and disposable paper wipers when the amount of solvent applied was 2 times the weight of the shop towel/wiper. The mean removal efficiency for disposable cloth wipers ranged from a low of 1.6 percent to a high of 68 percent at 2 times the weight of the material.

- The mean removal efficiency for screen bottom drums was only 4 percent for one experiment (using acetone with multiple wiper types) , and 28 percent for another experiment (using VM&P Naphtha with a wiper distribution equivalent to the first experiment).

- High volume air drying is very efficient, (provided there is a removal technology such as a carbon canister to collect the solvent vapors).

Many disposable wipers pass the Liquid Release Test even when considerable amounts of solvent are applied. Disposable paper wipers were tested using a laboratory protocol designed to evaluate whether or not liquids would be released when subjected to the overburden pressures of a landfill (SW-846 Method 9096, the Liquid Release Test). The test results indicate that, at solvent/wiper ratios consistent with minimal solvent load and/or the application of some removal technologies, solvent-contaminated wipers would <u>not</u> be expected to release liquid under landfill-like conditions of compression. More specifically,

- All except one combination of solvents and disposable wipers passed the Liquid Release Test for a solvent amount applied that equaled 50 percent the weight of the wiper. The one exception (MEK/Workhorse wiper), however, passed when 25 percent by weight of solvent to wiper was tested.

- All but 2 out of 17 tests passed the Liquid Release Test for a solvent amount applied that equaled 100 percent the weight of the wiper.

Recommendations

We believe policy changes are possible to the current regulatory framework for solvent-contaminated industrial shop towels and wipers. However, before proposing any changes, we believe further data gathering and analysis are desirable over the next several months to both support and validate those changes. These short-term efforts involve:

1. Conducting risk-screening analyses with the use of currently available multi-media risk assessment models to identify those situations (i.e., solvent-type, quantity of solvent and type of wiper), if any, under which the disposal of solvent-contaminated wipers does not pose a risk to human health and the environment.

2. Conducting additional experiments for combinations of low-end solvent-removal technologies (i.e. hand wringing or mechanical wringing in conjunction with screen-bottom drums) to further understand situations under which "free liquids" occur in the bottom of containers.

3. Conducting experiments to identify possible situations, if any, under which solvent-contaminated shop towels and wipers containing "no free liquids" could still self-ignite.

We expect to complete these tasks by March of 1998 and to follow that with consideration of proposed policy and/or regulatory changes.

Similarly, any policy changes proposed will strive to respond to the concerns of our various stakeholders. These concerns include:

- any rule change or policy change must be easy to understand and be practical
- flexibility is provided in how to achieve compliance
- minimal, if any, increase in compliance costs; if possible, decreases in compliance cost
- enhanced environmental protection
- encourage and foster use of pollution prevention
- reduce barriers to safe hazardous waste recycling

1. Solvent-Contaminated Shop Towels and Wipers Data Collection and Analysis

1.0 Introduction

This report presents the results of a data gathering effort by EPA to better understand the use and management practices of solvent-contaminated industrial shop towels and wipers utilized by industry to support their business operations. At issue is whether the current regulatory framework for solvent-contaminated industrial shop towels/wipers is effective and should not change, or whether this framework can be improved in terms of (1) protecting human health and the environment, (2) reducing the complexity of a generator's decision-making process with respect to the management of these materials, and (3) fostering pollution prevention where appropriate.

The data gathering effort described in this report is not meant to comprehensively characterize industry use and management practices for solvent-contaminated industrial shop towels and wipers. Rather, this effort is intended to provide a "snapshot" of common industry practices regarding the use and management of solvent contaminated shop towels and wipers. Because of the wide diversity of industry practices and the multiplicity of factors involved, a comprehensive characterization would be cost-prohibitive and unnecessary for determining the next steps in the Agency's process for reconsideration of the regulatory status of industrial shop towels/wipers.

The Current Regulatory Framework

In the simplest of terms, a solid waste is a hazardous waste under RCRA if it is (1) listed under 40 CFR Part 261, subpart D, (2) exhibits one or more of the characteristics of hazardous waste identified in 40 CFR Part 261, subpart C, or (3) it is a mixture of a solid waste that is listed in subpart D solely because it exhibits one or more of the characteristics of hazardous waste identified in subpart C, unless the resultant mixture no longer exhibits any characteristic of hazardous waste identified in subpart C. (See 40 CFR 261.3(a)(2)). Therefore, when a listed solvent is used in conjunction with (i.e., "mixed with") a disposable wiper or reusable shop towel, that shop towel or wiper is a hazardous waste when it no longer can be used. As such, the "spent" shop towel or wiper must be managed as a hazardous waste.

However, because of the site-specific nature of this issue, the current Federal policy with respect to RCRA regulatory status of solvent contaminated shop towels has been to defer resolution of specific questions to the EPA Regions and States. This policy was first articulated in a January 23, 1991 letter from Sylvia K. Lowrance, Director, Office of Solid Waste, to Lance R. Miller, Director of New Jersey's Hazardous Waste Management Division, where she stated:

We believe that the best course of action is to make a more comprehensive interpretation

in this rulemaking context [solvent-contaminated rags and wipers]. However, given our current resource levels and competing high-priority projects, we cannot select a particular target date for the final evaluation of this petition [Kimberley-Clark and Scott Paper]. In the meantime, Regions and States continue to use the current case-by-case approach on this subject.

This policy was reaffirmed in a February 14, 1994 memorandum to the EPA Regional waste management directors by the Michael Shapiro, Director, Office of Solid Waste, stating:

> Because there are many applications of wipers, we cannot at this time make any generic statements that all wipers are hazardous waste, or that all are not. A material that is a solid waste is by definition hazardous waste if it either 1) meets one of the listings in 40 CFR Part 261, Subpart D, or 2) exhibits one or more of the characteristics described in 40 CFR Part 261, Subpart C. Because there are no explicit listings for "used wipers" in Part 261, Subpart D, a wiper can only be defined as listed hazardous waste <u>if the wiper either contains listed waste, or is otherwise mixed with hazardous waste.</u> Whether or not a used wiper contains listed hazardous waste, is mixed with hazardous waste, only exhibits a characteristic of hazardous waste, or is not a waste at all, is dependent on site-specific factors; this is not a new policy. As a result, any determinations or interpretations regarding this diverse and variable waste stream should be made by the regulatory agency (i.e., EPA Region or State) implementing the RCRA program for a particular State. This has been our longstanding policy.

As discussed later, most States have concluded that <u>disposable</u> wipers and rags contaminated with a listed or characteristically hazardous solvent should be managed as a hazardous waste, while <u>reusable</u> shop towels that are industrially laundered need not be managed as a hazardous waste so long as specified conditions are met. These conditions primarily require that the generator ensures that the shipment of shop towels to the industrial laundry contains no free liquids (as defined by SW-846 Method 9095, Paint Filter Test), and the industrial laundry be permitted by the local POTW. A few States, such as Minnesota and Washington, go one step further and require facilities to extract solvent from reusable shop towels in order to ensure that "no free liquids" are transported off-site, and also to ensure that industrial laundries meet the permit requirements of their local POTW. In other cases, industrial laundries have arrangements with facilities (generators) to remove their solvents from the shop towels prior to being transported off-site in order to meet the permit requirements from the local POTW.

For several years, industry, particularly the disposable wiper industry, has requested and even petitioned EPA to address the issue of whether current federal policy was over-regulating the management of solvent contaminated industrial wipers. More specifically, concern has been expressed that many times only small amounts of solvent are applied to industrial wipers, and by the time the wiper is disposed of, little or no risks to human health and the environment should exist because very small or no amounts of solvent remain on the wiper. However, as described above, these wipers are regulated as a hazardous waste because they have been mixed with a

listed or characteristically hazardous solvent constituent.

The feedback that EPA has received on this issue as part of regulatory reform outreach efforts, and from industry representatives in the Printing Common Sense Initiative, has further encouraged EPA to address this issue.

Study Objectives

The objectives of this study have been to collect and analyze data on the use and management practices of solvent-contaminated industrial shop towels and wipers in order to (1) respond more effectively to the disposable wiper manufacturers' concerns that instances may exist where the management of solvent-contaminated disposable wipers does not pose an adverse risk to human health and the environment, and (2) better understand the implications of State policies on the use and management of reusable shop towels. From this effort, EPA will determine whether the current regulatory framework for solvent-contaminated industrial shop towels and wipers should be maintained or modified, or whether additional data are still necessary to further understand and clarify this issue. Specific questions addressed include:

- What are the use and management practices of industries using solvent-contaminated shop towels and wipers?
- Do instances or situations exist where the management of solvent-contaminated disposable wipers pose or does not pose an adverse risk to human health and the environment? If so, to what extent?
- How have the States addressed the solvent-contaminated shop towel and wiper issue? What conditions are required by the States for the management of these materials? Are these conditions effective?
- How effective are solvent removal technologies currently used by industry? Can these technologies support better environmental management of solvent-contaminated shop towels and wipers by industry?

Data Collection Approach

Data were collected primarily through site visits and laboratory experiments, and supplemented by data provided by industry, previous studies, and discussions with State and industry officials. More specifically, this involved the following steps:

- We conducted preliminary site visits to identify data we would want to collect to understand the use and management practices of solvent-contaminated industrial shop towels and wipers.

- We visited 17 sites and collected sampling data from nine of those sites. Sites visited represented the following industrial sectors: printing, auto body repair, aerospace manufacturing and maintenance, circuit board manufacturing, ship maintenance, and coating and adhesive testing and production. Data collected included:

  * types and amount of solvent applied to the shop towel/wiper
  * types and numbers of shop towels/wipers used by the facility
  * type of on-site management of shop towels/wipers
  * type of off-site management of shop towels/wipers
  * the amount of solvent remaining on the shop towel/wiper immediately after usage and 18-24 hours after usage
  * removal technologies used (if any) to extract solvent from the shop towel/wiper and estimated efficiency of that removal technology.

- We supplemented industry site visit data collection efforts with laboratory experiments in areas associated with:

  * estimating the efficiency of removal technologies for different solvent/shop towel and wiper combinations
  * estimating the evaporation rates for different types and amount of solvents on different types of shop towels/wipers
  * estimating the amount of solvent required to cause different types of industrial shop towels/wipers to fail the Paint Filter Test (SW-846 Method 9095)
  * estimating the amount of solvent required to cause different types of industrial shop towels/wipers to fail the Liquid Release Test (SW-846 Method 9096).

- We conducted a literature search of chemicals found in solvents used by the industries we visited, as well as an Internet search of applicable industry users of solvents and shop towels and wipers, to determine the potential range (low, medium, or high) of chronic carcinogenic and toxic risks from exposure to these chemicals.

- We reviewed and analyzed data provided by industry, as well as previous studies conducted by EPA in this area.

- We contacted several State and local officials to better understand whether compliance was a problem at industrial laundries in terms of accepting shop towels from facilities with "free liquids".

Remaining Chapters of This Report

Chapter 2 of this report summarizes the demographics of industry use and management practices of solvent-contaminated shop towels and wipers using data collected through the site visits, supplemented with data provided by industry.

Chapter 3 discusses the results of additional data collected and laboratory experiments conducted specifically associated with solvent-contaminated disposable wipers, particularly as they may affect or pose adverse risk to human health and the environment. Questions addressed include such topics as the extent evaporation impacts the amount of solvent remaining on disposable wipers after usage, the amounts of solvent necessary on a disposable wiper before it fails the Liquid Release Test and the effects of short-term storage in a closed container.

Chapter 4 discusses the results of additional data collected and laboratory experiments specifically associated with solvent-contaminated reusable shop towels. Questions address include such topics as the major conditions or requirements for the regulation of reusable shop towels by the States, the guidance industrial laundries provide their customers, the absorptive capacity of reusable shop towels before failing the Paint Filter Test, and the extent solvent from shop towels percolates from top to bottom in a container.

Chapter 5 discusses the results of laboratory experiments associated with the effectiveness of different solvent removal technologies for different combinations of solvent and shop towels/wipers.

Chapter 6 discusses the next steps for modifying the regulation of solvent-contaminated shop towels and wipers.

List of Exhibits

Exhibit 5-10: Average Weight of Unused Rag: 41.2 grams
Exhibit 5-11: Air Drying Efficiencies
Exhibit 5-12: Screen Bottom Drum Experiment, Kimtex/Acetone
Exhibit 5-13: Kimtex with Acetone Screen Bottom Drum Experiment (graphic)
Exhibit 5-14: Screen Bottom Drum, Acetone Wiper Weight, Top to Bottom of Drum (g)
Exhibit 5-15: Screen Bottom Drum, VM&P Naphtha Wiper Weight, Top to Bottom of Drum

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2. Demographics of Solvent-Contaminated Shop Towel and Wiper User Community

2.0 Introduction

This chapter presents data collected to better understand the use and management practices of firms utilizing solvent-contaminated shop towels and wipers. These data were collected during 17 site visits[1] in February and March of 1997, as well as through other sources, such as the Internet, and industry data.[2] The purpose of these data collection efforts is not to provide detailed statistically valid estimates of industry use and management practices for solvent-contaminated shop towels and wipers. Instead, the purpose is to provide EPA with an overview and understanding of the following:

- the types of industries using shop towels and wipers
- the RCRA regulatory status of a number of firms
- the types of shop towels and wipers used by industry
- the functions supported by these shop towels and wipers
- the on-site and off-site management practices for these shop towels/wipers
- the number of shop towels/wipers used daily or monthly
- the types of solvents used by industry
- the types of solvent-removal technologies used by industry

The 17 sites visited included both private and Federal facilities, representing:

- flexographic printing
- auto body repair
- aircraft maintenance
- circuit board manufacture
- coating and adhesive testing and production
- screen printing
- automotive maintenance
- ship maintenance
- aerospace equipment manufacture

These industries are believed to comprise the majority of industrial applications of wipers used with listed or characteristically hazardous solvents. (The automobile manufacturing sector is also a significant user of solvents in conjunction with shop towels and wipers.) Of the sites visited, data were collected at nine sites, and use practices were observed at the others. Exhibit 2-1

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[1] Sometimes solvent-contaminated shop towel/wiper operations were examined at more than one location within each of the sites or facilities visited.

[2] Additional data were provided by the American Automobile Manufacturers Association (AAMA), the Screen printing & Graphic Imaging Association International (SGIA), a consultant for the Flexographic Technical Association, and EPA's Office of Research and Development.

Exhibit 2-1
Summary of Site Visit Demographic Data

	Flexo/Off-Set Printers	Screen Printers	Auto Body Shops	Automotive Maintenance	Aircraft Maintenance	Ship Maintenance	Circuit Board Manufacture	Aerospace Instrument Manufacture	Coating and Adhesive Testing and Production
Number of Sites Visited w/ > 25 employees	2	1	0	2	1	2	1	1	1
Number of Sites Visited w/ < 25 employees	0	1	2	2	1	0	0	0	0
RCRA regulatory status (SQG, LQG)	1 SQG 1 NA	2 SQG	2 SQG	2 LQG 2 NA	2 LQG	2 LQG	1 LQG	1 LQG	1 LQG
non-RCRA permit status	c e	e	a b	n/a	c d	n/a	d	a	a
Approximate Number of Launderable Wipers Used per Month	400 - 2000	320	200-300	100 pounds	Data not available from facility	0	0	400	0
Approximate Number of Disposable Wipers Used per Month	0	1200	2000	50lbs	> 1200	Data not available from facility	2000 (paper)	40	Data not available from facility
Approximate Volume of Solvent Used per Month	36 gallons	12 gallons	37.5 gallons	15 gal.	55 gal.	Data not available from facility	5 gallons	20 gal.	Data not available from facility

	Flexo/Off-Set Printers	Screen Printers	Auto Body Shops	Automotive Maintenance	Aircraft Maintenance	Ship Maintenance	Circuit Board Manufacture	Aerospace Instrument Manufacture	Coating and Adhesive Testing and Production
Multiple or Single Use	multiple	multiple	1-single, 1-multiple	Data not available from facility	single and multiple	single	single	multiple	single
Observed Solvent/Wiper Ratio, wt./wt.	2/1	1/1-7/1	barely noticeable, 1/1, 2/1	Data not available from facility	3/1	0.3/1	3/1	0.1/1	Data not available from facility
Removal Technology Used	1 facility used centrifugation	1 facility used a screen bottom drum	none	none	none	none	none	none	none
Spent Material Disposition	laundry and municipal landfill	laundry	laundry, muni. landfill	incineration	fuel blending	incineration	hazardous waste	Data not available from facility	hazardous waste

a facility had a County Hazardous Waste Permit and a State Air Quality Permit
b facility had a County Hazardous Waste Generator License and a County Air Quality Permit
c facility had a County Hazardous Waste Permit
d facility had a County Hazardous Waste Generator License
e facility had a State Air Permit

summarizes the demographics of the sites visited. Copies of the trip reports from these site visits are provided in Appendix A. Material Safety Data Sheets (MSDSs) that were provided by these facilities for the solvents used with wipers in their processes are provided in Appendix B. Specific findings from these facility site visits are supplemented, where appropriate, by other industry data sources, including the following:

- The facilities visited included large quantity generators (LQGs) and small quantity generators (SQGs) with on-site employment ranging from 5-2200 personnel. (However, most facilities in industry using solvent-contaminated shop towels and wipers are believed to be small businesses classified as either conditionally exempt small quantity generators (CESQGs) or SQGs).

  - The average number of employees per firm from a screen printing and graphic imaging industry (SGIA) survey of 5,000 respondents was 15.

  - The distribution of employees per firm from a Flexographic Technical Association (FTA)survey of 63 respondents was:

Under 10 employees	-- 3 percent
10 to 50	-- 35 percent
51 to 100	-- 25 percent
Over 100	-- 37 percent

- Solvents reported to be used at sites visited included the following components: toluene, *iso*-propyl alcohol, methyl ethyl ketone, methanol, methyl *iso*-butyl ketone, ethyl acetate, acetaldehyde, acetone, diacetone alcohol, *n*-butyl alcohol, propyl acetate, ethanol, and *n*-propyl alcohol. (A detailed discussion of solvent usage is presented in Section 2.1).

  - An automobile manufacturing sector survey of four plants also found MSDSs for solvents consisting of two components, with at least one component of each solvent being petroleum naphtha. (Exhibit 2-2 summarizes the results of this survey.)

  - The Screenprinting & Graphic Imaging Association (SGIA) printing industry survey found the following solvents used most often: methyl ethyl ketone (18%), acetone (27%), xylene (19.5%), toluene (20%), and mineral spirits (25%).

  - The Flexographic Technical Association (FTA) survey found the following solvents used most often: ethanol, normal propanol and fast blends, as well as acetates and water cleaners.

- There are a wide range of shop towels/wipers on the market that can be categorized as:

  - Woven (launderable)

- Nonwoven wood pulp/synthetic fiber blend
- Paper wipers, and
- Recycled cloth (shirts/sheets, etc.) that are disposed of after usage.

During the site visits, woven or launderable shop towels were found to be of the same material composition (cotton), but varied in size. Disposable wipers on the market vary in both material composition (paper/wood, pulp/synthetic fiber blends and cotton/synthetic fiber blends) and size.

- Wiper use varied widely at the sites visited, from a reported low of 40 wipers/month, to a reported high of 2000 wipers/month.
  - The SGIA survey of 5,000 respondents found the following usage rates
    - 33% use between 1 - 25 shop towels/wipers per day (20 - 500 per month)
    - 33% use between 26 and 50 shop towels/wipers per day (520-1000 per month)
    - 33% use between 51 and 100 shop towels per day (1020 - 2000 per month).
  - An automobile manufacturing study found significant shop towel/wiper usage with ranges estimated from 150 and 1,832 per day.
- Solvent extraction technologies observed or used included:
  - centrifuging
  - mechanical wringing and
  - using screen-bottom drums.
- Facilities used solvents and shop towels/wipers for degreasing and surface cleaning operations.
- At the sites visited, application of the solvent to the shop towel/wiper occurred primarily through spraying, dipping or pumping.
- Observed on-site storage/management practices for used wipers included closed containers, open containers, or no container at all (i.e., stored on an open work surface).
- Reported disposal practices for disposable wipers included, hazardous waste landfills, incineration at both municipal incinerators and hazardous waste incinerators, and municipal waste landfills.
  - The automobile manufacturing survey indicated that shop towels either have the solvent removed prior to laundering or, in the case of disposable wipers are sent to a landfill.
  - The FTA survey reported most respondents using shop towels send them offsite to an industrial laundry. One member did report they send their disposable wipers offsite to be burned for energy recovery.

Exhibit 2-2
Summary of Automobile Manufacturers Wiper Usage Study[3]

Category	Plant 1	Plant 2	Plant 3	Plant 4
Type of Solvent	Petroleum Naphtha	Petroleum Naphtha Xylene	Petroleum Naphtha Isopropanol alcohol	Acetone Toluene Petroleum Naphtha
Type of ShopTowel/Wiper	Launderable	Disposable	Launderable	Launderable
Dry Weight of Towel/Wiper	42.6 grams	15.5 grams	31.2 grams	30.5 grams
Average Amount of solvent/vehicle	166.4 grams	49.1 grams	18.6 grams	57.8 grams
Solvent/dry weight ratio	1.95	1.6	0.3	0.95
Average Number of wipers used/vehichle	2	0.4	0.2	1
Estimated Number of Vehicles produced/year	229,025	165,243	188,070	163,488
Estimated Number of wipers used/year	458,050	66,097	37,614	163,488
Estimated Number of wipers used/day	1,832	264	150	654

[3]Case Study: Auto Body Solvent Wipe Process, National Pollution Prevention Center for Higher Education, University of Michigan, January 1996.

2.1 Types of Solvents Used

The type of solvent used in industrial applications represents the most significant variable that may require environmental regulation -- the other important variables being the amounts used on each wiper and the number of wipers used periodically by the facility. Three inter-related factors influence solvent usage: functional use, worker preference, and new and better products marketed by solvent manufacturers. Solvents in the workplace are used to clean equipment, clean up small spills and other applications. There appears to be a direct correlation between the type of equipment requiring cleaning and the type of solvents required to adequately clean the equipment. Some equipment may need strong solvent constituents, others less so. Worker preference appears to be a significant factor in type of solvent useage since they are the ones who must clean the equipment. They know first hand what products work or fail to perform adequately. Similarly, solvent manufacturers are marketing new products in response to user concerns, including the need to better clean the equipment as well as health and environmental concerns; i.e., reduction of volatile organic compound emissions.

In order to better understand the types of solvents used in the workplace, an analysis of MSDSs for solvents most likely to be used in conjunction with shop towels and wipers was conducted through the use of the Internet. As part of this exercise, we identified the MSDSs for solvents used in the target industries (printers, automobile manufacturers, auto body repair and maintenance shops, furniture manufacturers, aircraft manufacturers, etc.) Most, if not all, of these facilities identified a task (blanket wash, stripper, etc.) for which the solvent was intended, and from these tasks a determination was made as to whether there appeared a strong likelihood that the solvents were being used in conjunction with shop towels and wipers.

Exhibit 2-3 summarizes the results of analyzing the MSDS solvent chemicals from 78 facilities found through the Internet search.[4] (Appendix C provides the detailed data used to generate Exhibit 2-3 and other related exhibits.) These data are presented by industry, by type of task within the industry, and by hazardous waste determination. Solvents can be classified as a hazardous waste because they pose an ignitability risk, toxicity risk, or both an ignitability and toxicity risk. Within each of these classifications, such as ignitable-only, the solvent chemicals found in each MSDS were further analyzed to determine whether they would be classified as a listed hazardous waste, characteristically hazardous waste, combinations of both, or non-hazardous.

As seen, most of the MSDSs contained chemicals that would be classified as either characteristically hazardous (ignitable-only), or complex chemical mixtures that were both toxic and ignitable. Surprisingly, not one MSDS contained chemicals that would classify the material solely as a listed waste because of ignitability; i.e., acetone, xylene, etc.

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[4]This search, obviously, represents a very small percentage of the solvent MSDSs in use by industry.

Examined by industry, facilities within the printing sector performing blanket wash tasks, and furniture manufacturers performing coating/staining operations dominated the use of ignitable-only chemicals. Similarly, a large number of furniture repair facilities conducting paint removal operations were found to use MSDSs containing complex solvent blends, with chemicals that are either toxic, ignitable or both. Only 2 of 78 facilities in this data search used MSDSs with non-hazardous chemical blends.

Exhibit 2-4 displays the results of examining the MSDS search by the number of chemicals found in each solvent, the number of facilities using solvent blends with this number of chemicals, and the average number of hazardous materials in the solvent blend. As seen, the majority (57%) of facilities used relatively simple (fewer than three component) solvent blends. This finding is consistent with the observation made during the site visits.

Exhibit 2-5 summarizes the number of times specific chemicals appeared in the MSDSs found through the Internet search, and their RCRA hazardous waste clasification. As seen, toluene, methylene chloride, mineral spirits, methanol, petroleum distillate/naphtha/solvent, acetone and isopropyl alcohol appeared the most times, with these chemicals containing less than ten percent of the listed solvents, therefore primarily being classified as a hazardous waste because they are characteristically hazardous (ignitable). Data provided from a printing sector survey of 5,000 facilities found similar results with MSDSs containing MEK (18%), acetone (27%), xylene (19.5%), toluene (20%) and mineral spirits (25%).

Exhibit 2-3
Summary of MSDS Solvents Sorted by Regulatory Status
(As Found Through Internet Analysis)

	Ignitable only			Toxicity Characteristic only			Combo	Non HW
Industry Sector	Listed	Char.	Combo	Listed	Char.	Combo	TC/ignit. Combo	Non-Haz waste
Printing								
blanket wash		11		4			6	
thinner			1					
cleaner		2	3		1			1
Furniture								
lacq.thinner			1				2	
refinisher			1				3	1
coat/stain		13					2	
paint remov				1			13	
furn. polish		2	1				1	
Auto body								
degreaser		3		1			2	
lacq. thinner		1					1	
Totals	**0**	**32**	**7**	**6**	**1**	**0**	**30**	**2**

Exhibit 2-4
Analysis of Industry MSDSs by Number of Chemicals in Solvent
(As Found through Internet Search)

Number of Chemicals In Solvent (MSDS)	Number of Facilities Using Solvent Blend (With this No. of chemicals)	Average Number of Hazardous Wastes in Solvent Blend
1	5	1
2	21	2
3	19	2.5
4	13	3.5
5	13	4.6
6	1	5
7	2	7
8	3	6.7
11	1	5
19	1	16

Exhibit 2-5
Number of Instances Particular Chemicals Appeared in MSDSs

Chemical name	Number of times appearing in blend	HazWaste code
Toluene	19	F005 - LISTED TC/IG
Methylene chloride	18	F002 - LISTED TC
Mineral spirits	17	D001 - CHAR IG
Methanol	13	F003 - LISTED IG
Petroleum Distillate/Naphtha/Solvent	13	D001 - CHAR IG
Acetone	12	F003 - LISTED IG
Isopropyl alcohol	11	D001 - CHAR IG
VM&P Naphtha	11	D001 - CHAR IG
Aliphatic Naphtha	10	D001 - CHAR IG
MEK	7	F005 - LISTED TC/IG
VOC Compounds	7	D001 - CHAR IG
Stoddard Solvent	7	D001 - CHAR IG
Ethyl glycol	5	D001 - CHAR IG
2-Butoxyethanol	5	D001 - CHAR IG
Xylene(s)	5	F003 - LISTED IG
2-Propanol	4	D001 - CHAR IG

Chemical name	Number of times appearing in blend	HazWaste code
Ethyl alcohol	4	D001 - CHAR IG
Approximately 60 chemicals	between 1 and 3	

2.2 Risk Associated with Solvent Components

Toxicity

Based upon a review of facility material safety data sheets (MSDS) obtained through the Internet, or provided to us during industry site visits, a list of chemical compounds was identified that we believe encompass a large percentage of the compounds used in solvents with industrial shop towels and wipers. That list of compounds, together with any additional compounds found on the F001-F005 list, constituted the list that was evaluated for potential risk to human health and the environment, as defined by accepted estimates of chronic toxicity, carcinogenicity and the potential safety risk from solvent ignitability.

The compounds identified during the Internet search and from the MSDSs provided by industry were evaluated for toxicity by researching the available test, epidemiological and oncological data for possible toxic effects of each chemical. The focus of this part of the effort was exclusively on chronic toxicity, not acute toxicity, since the concern is primarily for long-term exposure as a result of disposal, and not work-place related health effects.[5] Unlike acute toxicological concerns, where numerical cutoffs have been established by consensus organizations, no quantitative assessment of the chronic toxicity was made for this analysis. Rather, a qualitative risk assessment was made to screen for solvent constituents by (1) establishing a conservative evaluation criterion, (2) reviewing all publicly available literature on the constituent, and (3) based on the application of the criterion, applying a low, medium or high ranking to the constituent. The following is an explanation of the criteria used to assess each of the chemicals and the concern values associated:

- Low Concern: This concern level was given to chemicals that exhibited very slight effects on humans, or if no human data are available, on animals. For example, chronic dermal irritation is an effect that is annoying but is in no way life debilitating or life-threatening. For example, the compound may be reported to cause dermal irritation, or repeated exposure to low levels of the compound in drinking water may be reported to be linked with diarrhea and mouth sores in humans.

- Moderate Concern: Any chemical that affects major organs of the body, but whose effects are reversible in nature, was assigned a moderate concern value. For example, the compound may be reported to cause cataracts, granulocytopenia, and polyneuropathy, or, for example, exposure to the compound may cause liver damage.

- High Concern: Any chemical that was listed as a possible, probable, or known human carcinogen by the Integrated Risk Information System (IRIS), the National Toxicology Program (NTP), or the International Agency of Research on Cancer (IARC) was assigned

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[5]As part of this analysis, carcinogenicity effects were also evaluated by researching available test, epidemiological and oncological data.

a high concern. If the substance causes death, paralysis, is a teratogen, or causes irreversible damage to the major organs of the body, then this chemical is undeniably of high risk to humans and was also assigned a high concern value. For example, the compound may have been reported to be a teratogen, transplacental carcinogen, equivocal tumorigenic agent, or to cause neoplastic effects.

Exhibits 2-6a to 2-6e summarize the results of this analysis. As seen, chemicals found on the MSDSs and Internet search are organized from low chronic toxicity to high chronic toxicity. For each chemical within a particular toxicity ranking, available information is provided on the carcinogenic effects. In some cases, a high carcinogenic effect is found even though the chemical might have a low or medium chronic toxicity ranking. This "contradiction" occurs because a high carcinogenic effect does not necessary result in a high toxic effect, and vice-versa. Similarly, "Not Classifiable" refers to testing not having been conducted to ascertain a carcinogenic effect.

Similarly, this analysis was conducted for individual chemicals, not blends of chemicals which are more commonly found in industry. Therefore, this risk ranking may underestimate the "real world" risks of solvent blends found in industry.

In addition, Appendix D provides the detailed information used to qualitatively rank each constituent. As seen in Appendix D for each constituent where chronic toxicity was evaluated, a concern level (H, M, or L) is supported by a brief statement of the reasoning behind the choice. Where applicable, this reasoning includes the source of the specific information. Also, a comprehensive fate profile was compiled giving the constituents' endpoint and amount of bioconcentration when released into the soil, water, or air.

This analysis contains many compounds that one does not conventionally think of as being components of solvent blends (e.g., talc and paraffin wax). These compounds are included in industrial solvent blends for properties other than solvation power, such as altering the volatility of the mixture so that it will evaporate slower or faster, or to provide abrasive action. While these compounds are not solvents, they were considered in the evaluation for toxicity because of the probability that they would be present in the spent solvent blend. Some of these compounds are common food additives, and as such, were classified as low toxicity.

Safety Hazard

As seen, many constituents were ranked low to moderate in terms of toxicity risk. Also, many of these low risk solvents appear to be used often by industry (MEK, acetone, VM&P naphtha, xylenes, and *iso*-propanol). However, constituents used in solvents also tend to be ignitable. Stated differently, a constituent can have a low toxicity risk, but a high ignitability risk. Exhibit 2-7 summarizes the results of examining the flash point for many of the constituents found in Exhibits 2-6a to 2-6e. As seen, many of these liquid constituents have a low flash point. At issue, however, is the flashpoint associated with solvents on industrial shop towels and wipers. Current RCRA rules associated with ignitable solids state that the material must be "capable, under standard temperature and pressure, of causing fire through friction, absorption of

Exhibit 2-6a
Low Chronic Toxicity

Chemical	CAS	Carcinogenicity
Solvent G	64742-94-5	Low
Trichlorofluoromethane (CFC-11)	75-69-4	Not Classifiable*
Acetone	67-64-1	Not Classifiable*
Isobutane	75-28-5	Low
Propane	74-98-6	Low
Nitrogen	7727-37-9	Low
Medium Aliphatic Naphtha	64742-88-7	Low
Propylene Dichloride	563-54-2	Not Classifiable*
Methyl Ethyl Ketone	78-93-3	Not Classifiable*
Titanium Dioxide	13463-67-7	Not Classifiable*
Cyclohexane	10-82-7	Low
2-Propanol	67-63-0	Not Classifiable*
Heptane	142-82-5	Not Classifiable*
Hydrogen Sulfate Sodium Salt	1847-55-8	Low
Isobutyl Alcohol	78-83-1	Low
Silicon Dioxide	7631-86-9	High (quartz); Low (others)
n-Butanol	71-36-3	Not Classifiable*
VM & P Naptha	8032-32-4	Low
Calcium Carbonate	471-34-1	Low
N-butyl Acetate	123-86-4	Not Classifiable*
Ethyl Benzene	100-41-4	Low
Xylene	1330-20-7	Not Classifiable*
M-xylene	108-38-3	Not Classifiable*
Nonylphenol Surfacant	68412-54-4	Low
Isobutyl Isobutyrate	97-85-8	Low
Stoddard Solvent	8052-41-3	Low
Petroleum Mineral Oil	64742-06-9	Low
Petroleum Distillate	8002-05-9	Low
non-Phenolic Ethoxylates	26027-38-3	Low
Solvent Naphtha	64742-95-6	Low
Methylcyclohexanone	1331-22-2	Low
White Mineral Oil	8042-47-5	Not Classifiable*
Phosporic Acid	7664-38-2	Low
Aliphatic Naphtha	64742-89-8	Low
Worum DPM	34590-94-8	Low
Ethylene Glycol	107-21-1	Not Classifiable*
1,2,3,4-Tetrahydronaphthalene	119-64-2	Low
Chlorobenzene	108-90-7	Low
1,1,2-Trichloro-1,2,2-trifluoroethane (CFC-113)	76-13-1	Low
1,1,2-Trichloroethane	79-00-5	High
Ethyl Ether	60-29-7	Not Established
Methyl Isobutyl Ketone	108-10-1	Not Established
m-Cresol	108-39-4	High
p-Cresol	106-44-5	High
Cresylic Acid	1319-77-3	Not Established
Pyridine	110-86-1	Not Established

Chemical	CAS	Carcinogenicity
2-Nitropropane	79-46-9	High

* Denotes: Not classifiable as to human carcinogenicity

Exhibit 2-6b
Low to Moderate Chronic Toxicity

Chemical	CAS	Carcinogenicity
Ethyl Acetate	141-78-6	Low
Nitric Acid	7697-37-2	Low
Cyclohexanone	108-94-1	Not Classifiable*
Ethyl toluene	611-14-3	Not established
1,2,4-Trimethylbenzene	95-63-6	Not established

* Denotes: Not classifiable as to human carcinogenicity

Exhibit 2-6c
Moderate Chronic Toxicity

Chemical	CAS	Carcinogenicity
Benzin	8030-30-6	Not established
Kerosene	8008-20-6	Not established
DOP	117-81-7	High
2-Butoxyethanol	111-76-2	Not established
Turpentine	8006-64-2	Low
Butyl Carbamate	55406-53-6	Low
Hexane	110-54-3	Not established
Ethyl Alcohol	64-17-5	Not Classifiable*
Trichloroethylene	79-01-6	High
Carbon Tetrachloride	56-23-5	High
ortho-Dichlorobenzene	95-50-1	Not Classifiable*
o-Cresol	95-48-7	High
Carbon Disulfide	75-15-0	Not Established
2-Ethoxyethanol	110-80-5	Not Established

* Denotes: Not classifiable as to human carcinogenicity

Exhibit 2-6d
Moderate to High Chronic Toxicity

Chemical	CAS	Carcinogenicity
Mineral Spirits	64742-47-8	Low
Hydrotreated Heavy Naphtha	64742-48-9	Not stablished
Toluene	108-88-3	Not Classifiable*

1,1,1-Trichloroethane	71-55-6	Low

* Denotes: Not classifiable as to human carcinogenicity

Exhibit 2-6e
High Chronic Toxicity

Chemical	CAS	Carcinogenicity
Benzene	71-43-2	High
Tetrachloroethylene	127-18-4	High
Ammonia	7664-41-7	Not established
Methanol	67-56-1	Not established
Methylene Chloride	75-09-2	High
Propylene Oxide	75-56-9	High
Phenol	108-95-2	Not Classifiable*
Nonylphenol	25154-52-3	Not established
Isopropanolamine PRG	78-96-6	Not established
Methyl Ethyl Ketoxime	96-29-7	High
Wet Nitrocellulose	9004-70-0	Not established
Sodium Chromate	7775-11-3	High
Hydroxypropyl Cellulose	9004-64-2	Not established
Hydrocarbon Propellant	68476-86-8	Not established
Propylene Glycol monomethyl ether acetate	108-65-5	Not established
4-Isopropenyl-1-Methyl-Cyclohexane	536-59-4	Not established

* Denotes: Not classifiable as to human carcinogenicity

Exhibit 2-7
Ignitability of Solvents

A solid waste exhibits the characteristic of ignitability if:

[...] It is a liquid, other than an aqueous solution, containing < 24% alcohol by volume, and it has a flash point < 60°C (140°F), as determined by a Pensky-Martens Closed Cup Tester, using the test method specified in ASTM Standard D-93-79 or D-93-80, or a Setaflash Closed Cup Tester, using the test method specified in ASTM standard D-3278-78, or as determined by an equivalent test method approved by the Administrator under the procedures set forth in Sections 260.20 and 260.21. (40 CFR 261.21)

Chemical	CAS Number	Flash Point
1,2,4-Trimethylbenzene	95-63-6	48 deg C
2-Ethoxyethanol	110-80-5	40 deg C
2-Nitropropane	79-46-9	28 deg C
2-Propanol	67-63-0	12 deg C
Acetone	67-64-1	-20 deg C
Ammonia	7664-41-7	11 deg C
Benzene	71-43-2	-11 deg C
Carbon disulfide	75-15-0	-30 deg C
Cyclohexane	10-82-7	-18 deg C
Cyclohexanone	108-94-1	46 deg C
Ethyl acetate	141-78-6	- 4 deg C
Ethyl toluene	611-14-3	39 deg C
Ethyl ether	60-29-7	-40 deg C
Ethyl alcohol	64-17-5	12 deg C
Ethyl benzene	100-41-4	15 deg C
Heptane	142-82-5	- 4 deg C
Hexane	110-54-3	- 22 deg C

Chemical	CAS Number	Flash Point
Hydrotreated Heavy Naphtha	64742-48-9	49 deg C
Isobutanol (n-Butanol)	71-36-3	35 deg C
Isobutyl Isobutyrate	97-85-8	38 deg C
Isobutyl Alcohol	78-83-1	28 deg C
Kerosene	8008-20-6	52 deg C
M-xylene	108-38-3	25 deg C
Methanol	67-56-1	12 deg C
Methyl ethyl ketone (MEK)	78-93-3	-7 deg C
Methyl isobutyl ketone	108-10-1	14 deg C
n-Butanol	71-36-3	35 deg C
N-butyl Acetate	123-86-4	22 deg C
Petroleum Distillate	8002-05-9	53 deg C
Propylene Glycol monomethyl ether acetate	108-65-5	42 deg C
Propylene Oxide	75-56-9	-37 deg C
Pyridine	110-86-1	17 deg C
Solvent G	64742-94-5	- 40 deg C
Stoddard Solvent	8052-41-3	40.6 deg C
Toluene	108-88-3	4 deg C
VM & P Naptha	8032-32-4	-46 deg C
Wet Nitrocellulose	9004-70-0	4 deg C
Xylene	1330-20-7	25 deg C

moisture or spontaneous chemical changes and, when ignited, burns so vigorously and persistently that it creates a hazard." (See 40 CFR 261.21 (a)(2).) Most States appear to address this issue by requiring facilities to pass the "no free liquids" test for solvent-contaminated shop towels and wipers. At issue is whether the absence of free liquids is sufficient to prevent self-ignition.

2.3 How Much Solvent Is Placed on a ShopTowel/Wiper?

Exhibit 2-8 summarizes data collected from the site visits regarding the amount of solvent placed on industrial shop towels and wipers. These amounts were calculated by first weighing and measuring the dry shop towel/wiper, and then after solvent was applied by the worker to the shop towel/wiper to derive a ration of solvent to dry wiper weight. As seen, there is wide variability in the amount of solvent placed on shop towels and wipers. Some of the facilities visited place relatively small amounts of solvent on the shop towel/wiper, a 0.1 to 1 wet to dry weight ratio, while others had between 2 and 3 times the solvent to dry weight ratio. One facility completely saturated their shop towel, having a ratio of 7 to1. Data collected from an automobile manufacturing sector study of 4 assembly plants found ratios of from 0.3 to 1 to 1.95 to1 per vehicle with the low ratio derived because the same wiper was used on 5 vehicles, while only one wiper was used per vehicle to derive a high solvent usage ratio (1.95).

Two findings emerge from these site visits. First, no trends in solvent application rates to shop towels/wipers were found across industries, as much as within some industries. The printing sector sites visited had a solvent application rate of between 2 to 1 and 3 to 1. The auto body repair had solvent application rates at the lower end, as did the other sites visited. However, within a particular facility, there did appear to be trends in solvent application rates, the most likely reason being that tasks involved in using solvents in conjunction with wipers are production-oriented, and therefore repetitive in nature. (Some of this is borne out later in Chapter 5 when we discuss solvent-removal efficiencies.)

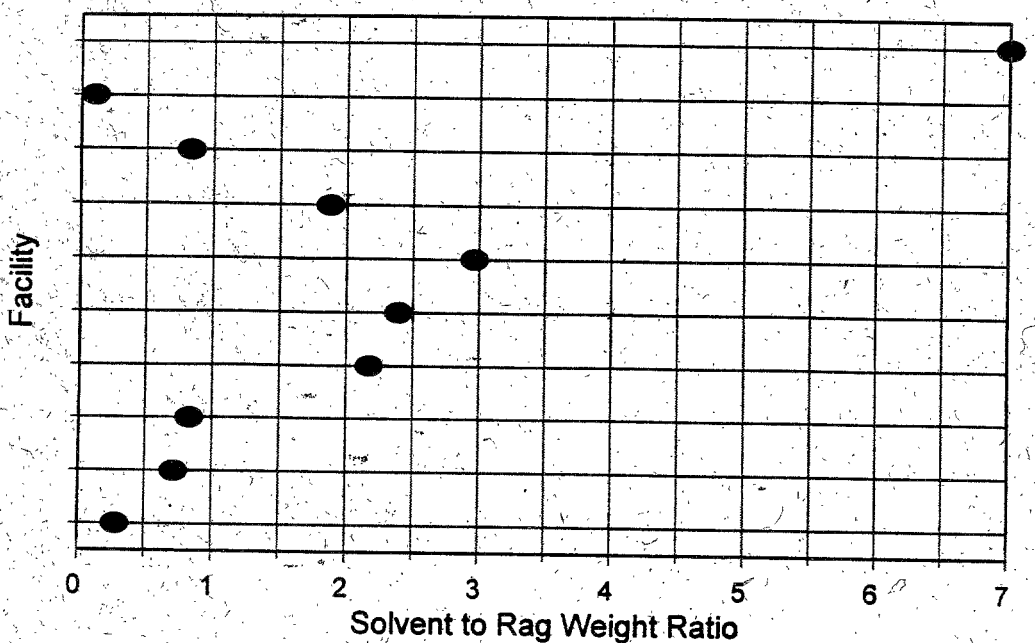
2.4 How Many Wipers Are Used Periodically by a Facility?

Another important factor **potentially** impacting the adverse risk from disposable wipers is the frequency or number of times a worker and facility must utilize a wiper in the course of business operations. Data collected during the site visits found the number of shop towels/wipers used varied from 40 to 2000 per month. A printing sector survey found about one-third of the 5,000 respondents equally divided between:

- 1 to 25 shop towels/wipers per day (20 -500 per month)
- 26 to 50 shop towels/wipers per day (520 - 1000 per month)
- 51 to 100 shop towels/wipers per day (1020 - 2000 per month)

Exhibit 2-8

Variability of the Amount of Solvent
Added to Rags Among Facilities



Similarly, the estimated number of shop towels used daily in the AAMA study ranged from 150 to 1,832. Again, this wide variability was directly related to the number of shop towels used on each vehicle, with one plant having operating practices where only one shop towel was used on each car before discarding, and another plant having operating practices where the shop towel was reused until it was completely dirty. We also were not able to correlate the relationship between wiper/shop towel usage and generator status; i.e., small quantity generator, large quantity generator.

Conclusions

As observed, there exists a tremendous amount of variability in the use and management practices of firms utilizing solvents in conjunction with shop towels and wipers. In fact, no two firms appear to have identical use and management practices in terms of type and amounts of solvents used, type and number of shop towels/wipers used per day, etc.

3. Solvent-Contaminated Disposable Wipers

3.0 Introduction

This chapter discusses the results of additional data collected during the site visits and data generated through laboratory experiments associated with solvent-contaminated disposable wipers.

A key hypothesis put forward by the disposable wiper manufacturing industry is that some facilities only use small amounts of solvent on disposable wipers, and by the time the wiper is discarded, very little solvent, if any, remains on the wiper. To test and understand this hypothesis better, we evaluated the following demographic issues:

- What types of solvents do industries use in conjunction with shop towels/wipers? Are these solvents listed hazardous wastes, characteristically hazardous wastes, or combinations of both?
- What chemicals appear to be used most often in solvents? How many chemicals appear to be found on a Material Safety Data Sheet (MSDS)?
- What do we know about the potential risks for these chemicals? To what extent are they a potential health hazard or safety hazard?
- What is the variability in the amount of solvent placed on industrial shop towels/wipers? Do any trends exist by industry or facility?
- What is the variability in the number of shop towels/wipers used daily or monthly at facilities visited or from data provided by industry?

As presented in Chapter 2:

- Solvents reported to be used included: toluene, *iso*-propyl alcohol, methyl ethyl ketone, methanol, methyl *iso*-butyl ketone, ethyl acetate, acetaldehyde, acetone, diacetone alcohol, *n*-butyl alcohol, propyl acetate, ethanol, and *n*-propyl alcohol. As used, these solvents are both listed hazardous wastes, and characteristically hazardous.
- Prevalence of constituents in solvent blends differs by industry, but certainly includes petroleum naphtha, methyl ethyl ketone, acetone, xylene, toluene, mineral spirits, ethyl alcohol, and *n*-propyl alcohol. Most MSDSs list more than one component.
- The solvent components investigated run the gamut from low to high toxicity and carcinogenicity, although the majority are classified as "low toxicity".

- Using both the data collected during site visits and data provided by industry, the number of wipers used varied from 40 to 5500 wipers per month.

In addition, we addressed the following questions during our site visits and laboratory experiments associated with solvent-contaminated disposable wipers:

- To what extent does evaporation impact the amount of solvent left on disposable wipers after usage?
- How much solvent is necessary on a disposable wiper before it fails the "No Free Liquids" and/or "Liquid Release Test"?
- What are the effects of short-term storage?

Sections 3.1-3.3 answer these three questions. Section 3.4 discusses the overall finding.

3.1 How Much Solvent Evaporation Occurs On Wipers?

A major characteristic of solvents is their volatility, or tendency to evaporate at normal temperatures and pressures. In an effort to understand the extent evaporation occurs on solvent-contaminated wipers, data measurements were taken at 4 sites visited for a sample of solvent-contaminated wipers at the beginning of a task, and between 18 and 24 hours after use. Two of the sites stored their "spent" wipers on shelves or open containers; the other two sites stored their "spent' wipers in closed containers. Exhibits 3-1 and 3-2 provide a summary of the measurements taken for the open and closed container sites, respectively.

As seen in Exhibits 3-1 and 3-2, the amount of solvent evaporation varied widely at these sites, from 40 to 100 percent. Factors influencing the high evaporation included the type of solvent applied; i.e., high volatility, and the very small amounts applied. However, as seen at one site, (TG2-1/1) high evaporation occurred when a considerable amount of solvent was applied as well. Conversely, at other sites, very little evaporation occurred. This result was somewhat surprising, but can probably be explained by such factors as the type of solvent blend used; i.e., low volatile chemicals, air circulation, storage (one wiper on top of another), lack of surface area and wiper absorptivity.

Experiments were conducted in the laboratory to measure the maximum absorptivity of the wipers using the Paint Filter Test (Method 9095, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846). In this test, wipers contaminated with measured weights of solvents were placed in conical paint filters, suspended in ring stands. The ratio of solvent weight to wiper weight was increased incrementally until solvent began to drip from the wiper in less than 5 minutes, the point of failure and termination of the test.

Exhibit 3-3 presents the results of these evaluations. These data clearly show that the

absorptivity of wipers varies dramatically from one wiper/shop towel type to another (from 2.5 times the weight of the wiper for the reusable wipers to 5.5 times the weight of the wiper for the most absorptive disposable product tested), and there appears to be little, if any, difference between solvents. The implications of these data are that wipers used with solvents at solvent/wiper weight ratios well within the range seen in industrial practice may contain free liquid, and that appreciable amounts of solvent may accumulate in the bottom of storage containers.

3.2 How Much Solvent Can A Disposable Wiper Hold Before Failing the Liquids Release Test?

Samples of disposable paper wipers were tested by SW-846 Method 9096, the Liquid Release Test. Method 9096 is a laboratory test designed to evaluate whether or not liquids will be released from sorbents when subjected to the overburden pressures of a landfill. In this procedure, a sample contaminated with a known amount of solvent is placed between two stainless steel supporting screens, with a piston on one side and filter paper on the other side. 50 psi is applied to the sample for 10 minutes. Any release of solvent to the filter paper is considered to be a material failure, and is indicative of potential release under landfill conditions. Disposable cloth wipers were not tested with Method 9096 because all of the other experiments with these materials had yielded results so variable (varying with the method and material of construction), that this method of testing was not expected to yield results that would demonstrate any trend.

Wiper samples were tested at a solvent burden equivalent to 50% of the weight of the wiper. If liquid was released at this concentration, the sample was retested at a solvent burden equivalent to 25% of the weight of the wiper. If liquid was not released, the sample was retested at a solvent burden equivalent to 100% of the wiper weight. All tests were run in duplicate. The data for all duplicate pairs were in complete agreement. Exhibit 3-4 presents the results of these evaluations.

Exhibit 3-1
Percent Change in Amount of Solvent Remaining on Disposable Wipers (18-24 Hours after Use) (Open Container/Stored on Shelf)

Site/Sample No.	Solvent Type	Wiper Type	Beginning Amount (Grams)	Amount Remaining (Grams)	% Solvent Evaporated
TG1-1/1	BP-308	WypAll	4.3	2.1	49
2	900 PreKleano	WypAll	4.7	1.3	72
3	BP-308	WypAll	4.2	3.5	16
TG1-2/1	DX 330	WypAll	30.2	17.7	41
2	Plastic Prep	WypAll	24.1	16.9	30
3	Plastic Prep	WypAll	20.1	11.3	44
4	DX 330	WypAll	27.0	15.0	44

Exhibit 3-2
Percent Change in Amount of Solvent Remaining on Disposable Wipers (18-24 Hours after Use) (Closed Container)

Site/Sample No.	Solvent Type	Wiper Type	Beginning Amount (Grams)	Amount Remaining (Grams)	% Solvent Evaporated
TG2-1/1	MEK	WypAll	42.8	1.0	98
2	MEK	WypAll	35.0	.9	97
3	MEK	WypAll	35.0	.9	97
4	MEK	WypAll	33.7	.6	98
5	MEK	WypAll	36.7	1.0	97
TG2-1/1	Xylene	Wypall	33.0	19.7	40
2	Xylene	WypAll	30.9	15.5	50
3	Xylene	WypAll	31.1	13.3	58
4	Xylene	WypAll	32.4	.7	98
5	Xylene	WypAll	34.5	16.4	52
TG2-1/1	Toluene	WypAll	1.3	.1	92
2	Toluene	WypAll	2.5	0	100
3	Toluene	WypAll	2.2	0	100
4	Toluene	WypAll	3.8	0	100
TG2-1/1	MEK	Kimwipes	.2	0	100
2	MEK	Kimwipes	.2	0	100
3	MEK	Kimwipes	.4	0	100
4	MEK	Kimwipes	.5	0	100
5	MEK	Kimwipes	.5	0	100
WG2-2/1	Lacquer Washup	HiDry Roll Towels	9.5	10.1	0
2	"	"	10.6	9.0	15
3	"	"	11.6	10.8	7
4	"	"	18.0	13.0	28
5	"	"	28.7	12.9	55

Exhibit 3-3
Summary of Paint Filter Test Experiments
for different Combinations of Wipers

Amt. of Solvent Type of material	2X[1]	2.5X	3X	3.5X	3.75X	4X	5X	5.5X	6X
Disposable Paper									
WORKHORSE									
Acetone	Pass	Pass	Pass	Pass	Pass	Fail			
VM&P Naphtha	Pass	Pass	Pass	Pass	Fail				
KIMTEX									
Acetone	Pass		Pass			Pass	Pass	Fail: 5 sec.	
VM&P Naphtha	Pass					Pass	Pass	Fail: 21 sec.	
KIMWIPES									
VM&P Naphtha	Fail:1min.								
DISP. CLOTH[2]	Fail: 15sec								

[1]The values 2X to 6X indicate the amounts of solvent added to each wiper type. For example, 2X means that an amount of solvent equaling 2 times the weight of the wiper was added to each wiper prior to placement in the paint filter.

[2]Only one test was conducted because the materials provided could not fit properly in the cone filter to conduct the test.

Exhibit 3-4
Results of Liquid Release Test

Liquid Release Test									
Solvent Type	Kimtex			Kimwipes			Workhorse		
	25%	50%	100%	25%	50%	100%	25%	50%	100%
Acetone		pass	pass		pass	pass		pass	pass
MEK		pass	pass		pass	pass	pass		
VM&P Naphtha		pass			pass	pass		pass	pass
Isopropanol		pass			pass	pass		pass	pass
Methylene Chloride		pass	pass		pass	pass		pass	pass
20/50/30, v/v/v, VM&P/IPA/MEK		pass	pass		pass	pass		pass	pass

As shown in this exhibit, solvent/wiper ratios consistent with minimal solvent load and/or the possible application of some removal technologies do not appear to release liquid under landfill-like conditions. In fact, most of the commonly used disposable wipers can usually hold a substantial amount (100 percent the dry weight of the disposable wiper) before failing the Liquid Release Test. However, these findings do not take into account other materials co-disposed in a landfill or rainfall that could "trigger" a release to the environment.

As seen, of the six solvents tested, Kimtex passed four of the 100% tests and all of the 50% tests, Kimwipes passed all of the 100% tests and the Workhorse passed all but one of the 50% and 100% tests.

3.3 The Effects of Percolation in Closed-Container Storage

During the laboratory phase of the project, we also investigated some of the effects of closed-container management on contaminated wipers by packing solvent-laden wipers into 5 gallon steel cans with close-fitting lids. The wipers were contaminated with an amount of solvent equivalent to twice the weight of the wiper. As with the screen bottom drum experiments, the number of tests conducted was maximized by packing more than one wiper type in a drum. Wiper types were separated by barriers made of stiff aluminum hardware cloth. Experiments were conducted using VM&P Naphtha, MEK, and Acetone. Only one solvent was tested per drum. Wipers were reweighed approximately 18-24 hours after they were packed into the drum, in order from top to bottom of the pile. The resulting data were examined for any apparent gradient of wiper weight (due to solvent migration).

Exhibit 3-5 presents a summary of the data, and Exhibit 3-6 provides a graphical depiction of the weight gradient from the top to bottom of the pile for one wiper type (Workhorse) with multiple solvents. As evidenced by the "% difference" column in this exhibit, the weight gradient seen is both significant and dramatic, with wiper weight gains at the bottom of the pile ranging from 90% to 158%. It is, in fact, considerably more dramatic that the gradient seen in the screen-bottom drum experiments. This may be attributable to the fact than the wipers in the bottom of the closed-container experiments were soaking up the solvent that we saw as residual solvent in the bottom of the screen-bottom drum experiments. Data for other wiper types are presented in Appendix E.

3.4 Do situations exist where solvent-contaminated disposable wipers do <u>not</u> pose an adverse risk to human health and the environment?

Probably, but we do not know the extent.

Several factors explain this finding. First, even from the small number of sites visited, at least two instances were found where very small amounts of listed solvents were used in conjunction with disposable wipers. With thousands of facilities using disposable wipers daily, there is the very strong likelihood that other facilities are using small amounts of listed solvents

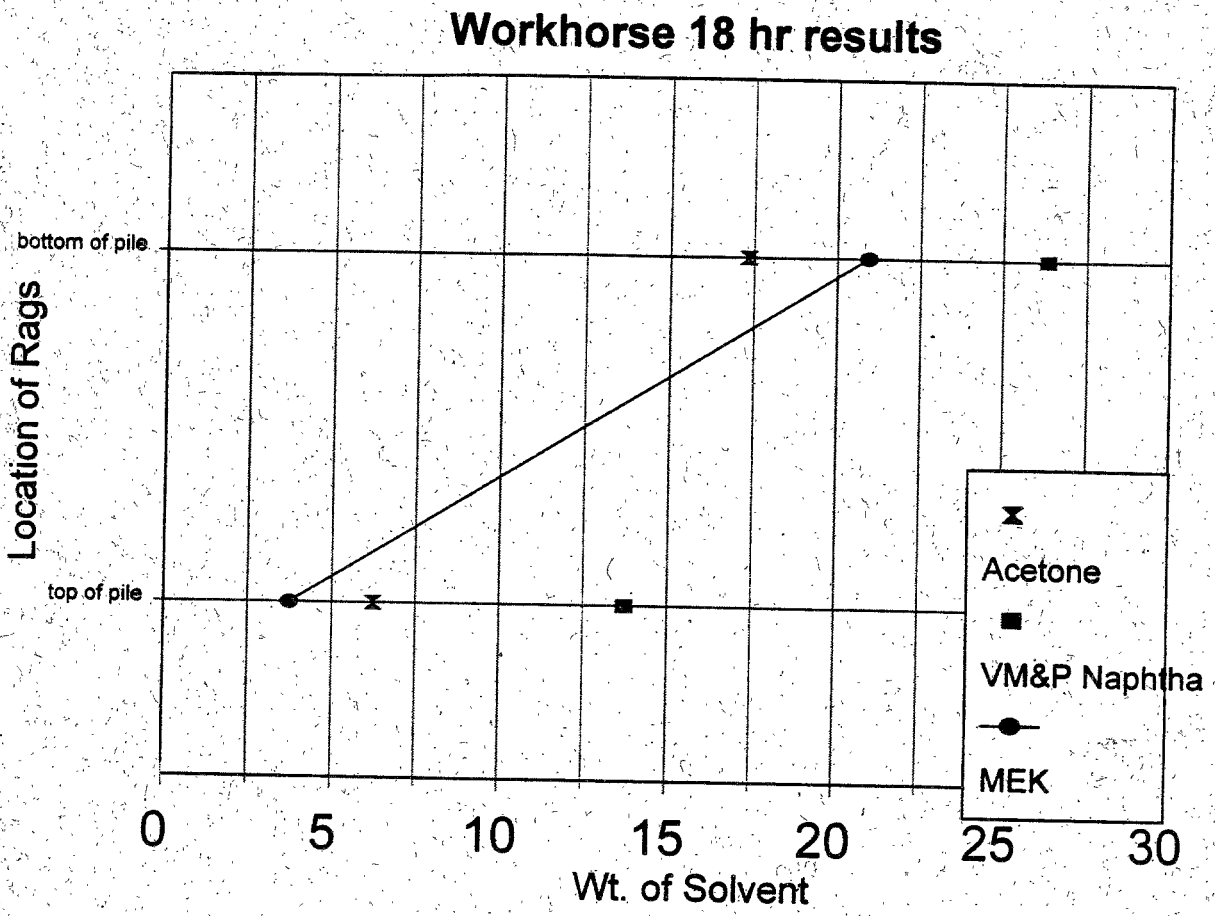
on their disposable wipers as well. Second, from data gathered through the site visits, and data provided by industry, some facilities also do not use very many wipers on a daily basis. Therefore, situations are bound to exist where small amounts of solvent are used in conjunction with small numbers of disposable wipers.[3] Third, total evaporation can occur. From data collected at two sites, almost all, if not all, of the solvent placed on wipers evaporated. Therefore, other situations are bound to exist where there is no or very small risks from disposal of these wipers, particularly if the amounts are small and the type of solvent is volatile. Fourth, small amounts of solvent on wipers do not fail the Liquid Release Test, therefore liquids from external sources, such as rain, become the dominant factor in triggering solvent releases from disposables placed in landfills.

[3]This assumes that metals contamination would be addressed separately by the generator.

Exhibit 3-5
Summary of Percolation Effects in Closed Container
Wiper Type: Workhorse
(Base Weight of Wiper - 10.48 grams)
Change in Wiper Weight Measured 22 Hours After Start of Experiment

Solvent Type	Solvent Weight (g) Top of container	Solvent Weight (g) Middle of Container	Solvent Weight (g) Bottom of Container	% Difference Top to Bottom
Acetone	7.15	12.62	13.65	90.9
VM&P Naphtha	13.32	18.62	25.72	93.1
MEK	10.52	17.12	27.12	157.8

Exhibit 3-6


Workhorse 18 hr results
bottom of pile
top of pile
Location of Rags
0
5
10
15
20
25
30
Wt. of Solvent
Acetone
VM&P Naphtha
MEK

4. Solvent-Contaminated Reusable Shop Towels

4.0 Introduction

This chapter discusses the results of additional data collected associated with reusable shop towels. Included in the discussion are the results of data collected during the site visits, data generated through laboratory experiments, and data obtained from industry sources. Questions addressed include:

- What are the major conditions/requirements for the regulation of reusable shop towels by the States?
- What guidance do industrial laundries provide their customers?
- What is the absorptive capacity of reusable shop towels before failing the Paint Filter Test (no free liquids)?
- To what extent do solvent-contaminated industrial shop towels percolate from top to bottom in a container?

4.1 Summary of Selected State Programs Associated with Solvent-Contaminated Shop Towels and Wipers

Appendix F summarizes the policies **or** regulations for a sample of selected State programs associated with solvent-contaminated shop towels and wipers. This summary suggests the following concerning State programs:

- Most State programs appear to issue policy guidance rather than promulgate State rules in addressing this issue.
- Most states appear to have provided reusable shop towels with a conditional exemption from the hazardous waste rules rather than a conditional exclusion from the definition of solid waste.[1]

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[1]Solvent-contaminated shop towels and wipers are "spent materials" when they have completed their useful function. Under RCRA, "spent materials" are defined as any material that has been used and as a result of contamination can no longer serve the purpose for which it was produced without processing. (See 40 CFR 261.1(b) (2)(ii)(1)). Similarly spent materials being reclaimed are defined as solid wastes.

Almost all States regulate disposable wipers as hazardous wastes.

- Specific requirements (conditions) vary among the States, but most have two common themes:

  (1) "no free liquids" in shop towels leaving facility (as confirmed by Paint Filter Test)
  (2) facilities using solvent-contaminated reusable shop towels should send their materials to an industrial laundry that has a local pretreatment permit to discharge their waste waters to a POTW.

- Other characteristics found in several States were the requirement to manage these materials as hazardous wastes until sent off-site (i.e., closed containers, specific labeling).

- Only two States were found to require solvent contaminated wipers to be wrung out. These States, Minnesota and Washington, did so because of problems POTWs were having with their industrial laundries and also because of potential transportation problems with ignitable wastes.

- Only one State, Massachusetts, appears to have created a level playing field between reusables and disposables. In effect, if either a disposable wiper or reusable shop towel passes the paint filter test, then the shop towels/wipers receive a conditional exemption from the hazardous waste regulation.

4.2 Industrial Laundry Guidance for Reusable Shop Towels[2]

The Uniform & Textile Service Association (UTSA), a trade association for industrial laundries, has issued guidance to both industrial laundries and their customers to use in managing solvent-contaminated reusable shop towels. This guidance, whether directed to industrial laundries or their customers, focuses on eliminating free liquids from textiles (shop towels) prior to transportation and laundering. The general responsibilities for the textile company include:

- Implementing all appropriate work practices and procedures to eliminate the transportation of textiles bearing free liquid back to the textile rental company,

- Communicating with the customer to ensure that textiles bearing free liquid will not be accepted or transported to the textile rental company, and

---

[2]See "Management Practices for Soiled Reusable Textile Handling", Uniform & Textile Service Association, November 1996, pages 1-2.

- Complying with all applicable EPA, DOT, and OSHA regulations and other applicable federal, state and local regulations

The general responsibilities of the customer include:

- Using a collection system or other process to remove any free liquids from the textile
- Placing the soiled textile holder outside of a collection system prior to transporting it to the textile rental company if the soiled textile does not bear any free liquid

Similarly, the UTSA guidance pays special attention to the potential effects of solvent percolation from the top to the bottom of the collection system. They state:

> *Soiled textiles that do not bear free liquid may, when placed in soiled textile holder, accumulate free liquid as gravity pulls liquid from soiled textiles at the top of the soiled textile holder onto soiled textiles at the bottom of the soiled textile holder. If the customer determines that free liquid is accumulating on soiled textiles in a soiled textile holder, the customer must place the textiles bearing free liquid into a collection system until the textiles no longer bear free liquid.*[3]

4.3 When do Solvent-Contaminated Shop Towels and Wipers Fail the "No Free Liquids" Test?

As seen above, most State programs provide generators a conditional exemption from the definition of hazardous waste if their reusable shop towels contain "no free liquids" when sent off-site to an industrial laundry. In order to better understand what this condition meant in practical terms, experiments were conducted in the laboratory to measure the maximum absorptivity of the wipers using the Paint Filter Test (Method 9095, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846). In this test, towels contaminated with measured weights of solvents were placed in conical paint filters, suspended in ring stands. The ratio of solvent weight to towel weight was increased incrementally until solvent began to drip from the towel in less than 5 minutes, the point of failure and termination of the test.

Exhibit 4-2 presents the results of these evaluations. The implications of these data are that towels used with solvents at solvent/towel weight ratios well within the range seen in industrial practice may contain free liquid, and that appreciable amounts of solvent may accumulate in the bottom of storage containers or beneath laundry bags.

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[3]Ibid, page 2.

Exhibit 4-1
Summary of Paint Filter Test Experiments
for different Combinations of Shop Towels

Amt. of Solvent Type of material	2X[4]	2.5X	3X	3.5X	3.75X	4X	5X	5.5X	6X
REUSABLE SHOP TOWELS									
Acetone	Pass	Fail:5 sec							
VM&P Naphtha	Pass	Fail:5 sec							

[4]The values 2X to 6X indicate the amounts of solvent added to each towel type. For example, 2X means that an amount of solvent equaling 2 times the weight of the wiper was added to each shop towel prior to placement in the paint filter.

4.4 Effects of Percolation

Another important factor to understand with respect to meeting the "no free liquids" condition required by many State policies (and UTSA guidance) is the extent percolation could occur from solvent in shop towels gravitating from the top to the bottom of containers. Stated differently, to what extent does the weight of solvent in contaminated shop towels put pressure on the shop towels below to release free liquids? To understand this phenomenon better, samples of solvent-contaminated shop towels were taken at 2 sites to measure the difference in shop towel weights between the top and bottom of containers. Average weights of these samples were then added and divided to derive an average for the top and bottom of the containers[5] were calculated.

Site	Avg. Weight (g) (Top)	Avg. Weight (g) (Bottom)	% Diff.
1	27.5	37.7	37.1
2	19.0	24.6	29.5

As seen in the above table, there is considerable difference in the amount of solvent found between the top and bottom of the containers at the 2 sites, 37 and 29.5 percent, respectively. Therefore, percolation is considerable, and can result in "free liquids" if sufficient amounts of solvent are placed on individual shop towels.

[5]This calculation assumes that the amount of solvent put on each wiper is relatively uniform and does not vary significantly from one to the next.

Exhibit 4-2
Screen Bottom Drum, Towel
Weight, Top to Bottom of Drum (g)

Acetone Reusables	VM&P Naphtha Reusables
47	59.6
56.8	64.3
62.7	59.7
60.5	55.6
57.8	55.2
63	60.7
60.7	56.2
55.7	53.4
54.6	58.4
57	60.3
58.4	56.6
61.4	
68.7	
58.8	
63.6	

4.5 Conclusions

From the above, the following observations can be made:

1. Reusable shop towels fail the Paint Filter Test (PFT) when solvent is applied at an amount that is 2 to 2.5 times the dry weight of the shop towel.

2. Many facilities (see results of site visits and extrapolate to industry at large) apply solvent at amounts close to or exceeding the PFT threshold.

   * Percolation only exacerbates the potential number of situations where free liquids can accumulate in the bottom of containers if wringing does not occur.

3. Our site visits observed only 1 facility outside of Minnesota using any type of solvent removal system.

   * Facilities we visited using saturated shop towels did not wring them out. (One facility used a screen bottom drum.)

4. Without wringing out the shop towel, facilities using large amounts of solvent on their shop towel will fail the Paint Filter Test for "no free liquids" and be inconsistent with State rules and policies. Also note that a previous study conducted by EPA found similar problems with solvent-contaminated shop towels and wipers.[6]

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[6]See Final Report: Industry Profile of solvent-Contaminated Rags and Wipers, MRI Report, EPA Contract No. 68-01-7287, June 20, 1990, page 38.

5. Solvent-Removal Technology Effectiveness

5.0 Introduction

This chapter addresses the effectiveness of several currently available techniques and technologies for removing solvents from shop towels and wipers. Solvent removal technologies provide a means for users of reusable shop towels to meet the "no free liquids" test required by many States as a condition from hazardous waste regulation. These data also provide useful information that can be used if the Agency intends to propose modifications to the current regulatory framework.

The following solvent removal technologies were evaluated, either during our site visits, or during the laboratory phase of this effort.

- hand wringing
- mechanical wringing
- controlled air drying
- screen-bottom drums
- high-speed centrifugation (data generated during one site visit and submitted by an industrial source (see Appendix G).

Similarly, the following solvents were used in conducting experiments: methyl ethyl ketone (MEK), VM&P Naphtha, acetone, *iso*-propyl alcohol, and methylene chloride. These solvents were used because they provided a range of volatility and toxicity. Three types of disposable paper wipers, and 1 type of reusable shop towel were used to conduct the experiments. Disposable cloth wipers were also used to conduct the experiments. The three types of disposable wipers chosen are used frequently by industry. They were Kimwipes, Kimtex and Workhorse. Each of these varied in weight, size and thickness, with Kimwipes being very light in weight (2.8 grams), measuring 15 x 17 inches. and comparable to tissue paper, while at the other end, the Workhorse wiper weighed 10.48 grams but was smaller (and therefore thicker) in size, 12.25 x 12.25 inches.

The launderable shop towels used for the experiment weighed 25 grams and measured 14 x 14 inches. The disposable cloth wipers, conversely, differed from one another in weight, thickness and surface area.

5.1 Hand Wringing

Hand wringing experiments were conducted at solvent concentrations of 0.5 (0.5X) and 2 (2X) times the weight of the wiper or shop towel. These solvent concentrations were selected as being representative of the solvent usage in industry, based on data collected during site visits. Shop towels and wipers were weighed before wringing, twisted by hand until no more solvent

appeared to be squeezed out, and then weighed again. Five measurements were made for each wiper/solvent combination using MEK, VM&P Naphtha and acetone. Three measurements were made for each wiper/solvent combination using *iso*-propyl alcohol, methylene chloride and a 3-part solvent mixture. The weight of solvent removed was calculated by difference, and the removal efficiency was calculated as follows:

removal efficiency = (wt of solvent removed/wt of solvent added) x 100

Exhibits 5-1 and 5-2 present summaries of the removal efficiencies calculated for disposable paper and launderable wipers at one-half and two times the weight of the wiper or reusable shop towel. As seen:

- hand wringing removal efficiencies vary between wiper types with the Workhorse wiper yielding the lowest extraction efficiencies
- the mean removal efficiencies are greater when more solvent is on the wiper -- but not that much greater
- methylene chloride (CH_2Cl_2) resulted in much lower extraction efficiencies with all wiper types than did the other solvents. This may be attributable to the fact that methylene chloride is significantly more volatile than the other solvents tested, and was evaporating off of the wipers fast enough to reduce the initial weight taken in the experiments, thus reducing the difference in weight calculated after wringing.

The implications of these data are that hand wringing is not a very effective technology. As seen, for small amounts of solvent on a disposable wiper (0.5 times the weight of the material), less than 10 percent of the solvent, on average, is removed. For larger amounts of solvent; i.e., two times the weight of the wiper/shop towel, removal efficiencies for disposable wipers increase only slightly for some, and actually decrease for the Workhorse. Overall, the mean removal efficiency for disposables tested at two times the weight of the wiper/shop towel varied from a low of 4.6 percent for the Workhorse wiper product to a high of approximately 24 percent for Kimwipes.

One important factor also influencing the hand wringing removal efficiency was the person performing the experiment. At the laboratory, three people were involved in performing these experiments -- each with their own individual hand strengths. Similarly, we did not differentiate what experiments were conducted by any one individual. As a result, a "stronger" person could have performed the 0.5X experiment, deriving a higher removal efficiency than at 2X. (See for instance the Workhorse/acetone results at 0.5X and 2X.). For reusables, the mean removal efficiency was 3.45 percent at 0.5 times the weight of the shop towel, and 11.3 percent at 2 times the weight of the shop towel.

Exhibit 5-1
Hand Wringing Removal Efficiencies
(0.5 Times the Weight of theWiper/Shop Towel)

	Kimwipes	Workhorse	Kimtex	Reusables	mean	1 std.dev.
Acetone	9.17	14.52	14.40	5.87	10.99	3.66
MEK	11.68	3.72	9.45	3.79	7.16	3.49
VM&P Naphtha	3.92	1.08	3.34	0.69	2.26	1.39
mean	8.25	6.44	9.06	3.45		
1 std. dev	3.23	5.82	4.52	2.12		

Exhibit 5-2
Hand Wringing Removal Efficiencies
(2 Times the Weight of the Wiper/Shop Towel)

	Kimwipes	Workhorse	Kimtex	Reusables	mean	1 std. dev.	
Acetone	18.15	5.71	12.85	11.10	12.0	4.4	37%
MEK	23.34	4.86	12.72	5.68	11.6	7.4	64%
VM&P Naphtha	27.97	2.05	25.76	11.49	16.8	10.6	63%
3-part mixture	23.57	3.08	13.27	10.17	12.5	7.4	59%
Isopropanol	39.78	7.21	19.18	22.59	22.2	11.7	53%
CH2Cl2	10.83	4.40	10.08	6.59	8.0	2.6	33%
mean	23.9	4.6	15.6	11.3			
1 std. dev.	8.9	1.7	5.3	5.5			
	37%	37%	34%	49%			

Exhibit 5-3 presents hand wringing removal efficiency data generated using **disposable cloth wipers** at a solvent to wiper ratio equivalent to twice the weight of the wiper. As seen, there is a significant amount of variability not only by type of cloth, but solvent type as well. The removal efficiency at the lower end is less than 2 percent, while at the high end, the removal efficiency is as high as 68 percent (see isopropyl alcohol/flannel shirt). Similar data were generated using disposable cloth wipers saturated at a solvent to wiper weight equivalent to one half (0.5) times the wiper weight.

The removal efficiencies generated using disposable cloth wipers are much more variable than those generated from reusable (launderable) shop towels, illustrated in Exhibit 5-4, which contrasts the removal efficiencies obtained when hand wringing launderable shop towels and disposable cloth wipers laden with twice their weight in acetone. As is evidenced by this exhibit,

the launderable shop towels behave much more consistently. This is true of all of the experiments conducted --- the performance of the disposable cloth wipers is dependant on the fabric of the wiper, and can vary drastically from one fabric type to another. All of the raw data generated in the hand wringing experiments are contained in Appendix G.

Exhibit 5-3
Disposable Cloth Wipers, Hand Wringing,
Amount of Solvent 2 Times Weight of Wiper

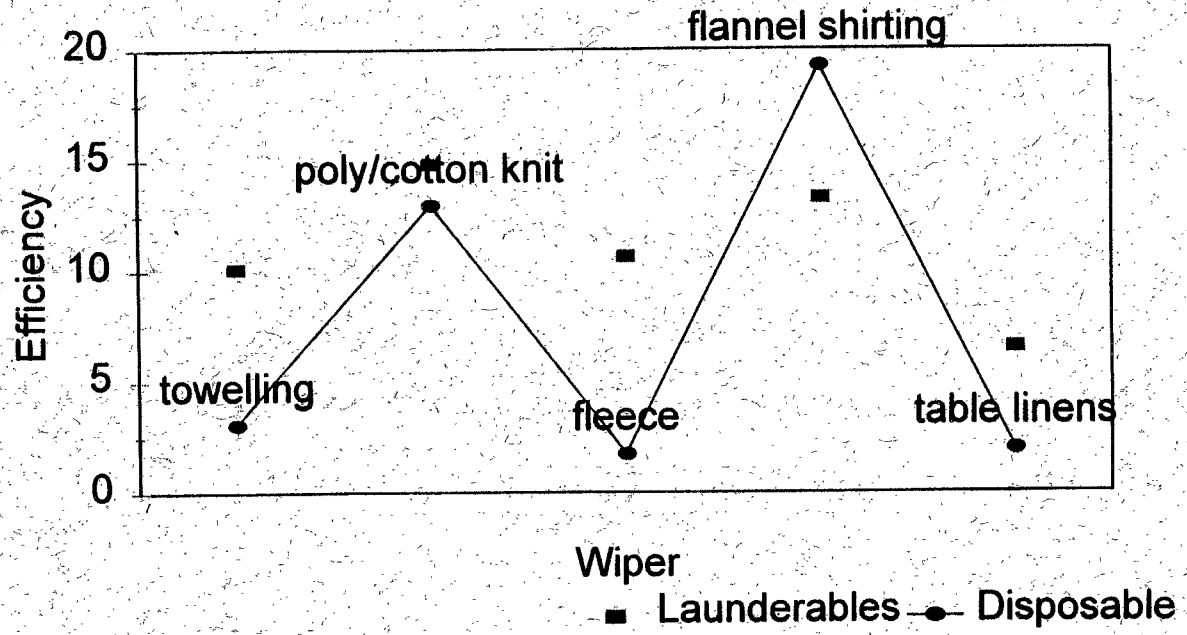
Solvent/Type of Disposable Cloth	Knit	Flannel	Table Linen	Towel	Broadcloth	Fleece
Acetone	13.00	19.29	1.97	3.10		1.75
MEK	11.19	8.87	1.59	1.53		1.60
VM&P Naphtha	16.57	24.62	8.54	19.38		3.51
3 Component Mix[1]	10.45; 11.72					
IPA		47.44; 68.25			31.84	
Methylene Chloride		10.75	48.23		11.31	

[1]20% VM&P Naphtha; 50% IPA, 30% MEK

Exhibit 5-4

Removal Efficiencies of 2X Acetone

Between Launderables & Disposables



5.2 Mechanical Wringing

All mechanical wringing experiments were conducted using a mangle-type mechanical wringer (purchased from Lab Safety Supply) at solvent concentrations of 0.5 and 2 times the weight of the wiper. The removal efficiency was calculated using the same process as that used for the hand wringing experiments. Wipers were weighed, passed once through the mechanical wringer, and weighed again after wringing. Five measurements were made for each disposable paper and launderable cloth wiper/solvent combination. Three measurements were made for the disposable cloth wipers for each wiper/solvent combination because of the limited availability of disposable cloth wipers. The disposable cloth wipers were selected randomly for testing. The weight of solvent removed was calculated by difference, and calculated using the same formula as that used for hand wringing.

Exhibits 5-5 and 5-6 present a summary of the removal efficiencies calculated for disposable paper and launderable wipers at 0.5 and 2 times the weight of the shop towel/wiper, respectively. Exhibit 5-7 also presents a graphical depiction of the removal efficiencies at 2 times the weight of the shop towel/wiper. These exhibits demonstrate clearly that:

- mechanical wringing solvent-removal efficiencies vary between disposable paper wipers and launderable shop towels, sometimes significantly.
    - of the disposable paper wipers tested, Kimwipes and Kimtex behave similarly with respect to mechanical wringing removal efficiency, with consistently less solvent extracted from the Workhorse brand.
    - there is less difference in mean solvent-removal efficiencies between the different solvents tested, except for methylene chloride (CH_2Cl_2).
- the mean removal efficiencies are greater when more solvent is on the wiper, approximately 13% to 30% at a solvent weight equivalent to twice the wiper weight, and approximately 7.5% to 19% at a solvent weight equivalent to half the wiper weight, and
- the variability between measurements decreases as the amount of solvent on the wiper increases.

Exhibit 5-8 presents mechanical wringing extraction efficiencies measured on **disposable cloth wipers** at a solvent weight equivalent to twice the wiper weight. It is more difficult to make summary judgements about these experiments because the variability in removal efficiency between fabric types is so large. However, for the experiment conducted at 2 times the weight of the disposable cloth wiper, the solvent-removal efficiency ranged from 10.85 to 55.8 percent, or well within (and many times greater than) the range of removal efficiencies for reusable shop towels and disposable paper. Solvent-removal efficiency data generated at 0.5 times the weight of the disposable cloth wiper are similar to the results of the launderables and

disposable paper wipers at the same weight, and presented in their entirety in Appendix I.

The results of these experiments imply that mechanical wringing may remove as much as 30% of the solvent from spent disposable paper and reusable shop towels, and as much as 50% for some types of disposable cloth wipers. All of the raw data generated in the mechanical wringing experiments are contained in Appendix H as are statistical analyses of these data, which demonstrate that the differences discussed here are statistically significant.

Exhibit 5-5

Mechanical Wringing Efficiencies (%), 0.5X							
	Kimwipes	Workhorse	Kimtex	Reusables	mean	1 std.dev.	
Acetone	26.29	10.09	5.57	9.39	12.84	7.96	60%
MEK	10.05	9.39	15.98	14.80	12.56	2.87	23%
VM&P Naphtha	0.00	3.00	34.62	3.97	10.40	14.06	135%
mean	12.11	7.50	18.72	9.38			
1 std. dev	10.83	3.19	12.02	4.42			
	89%	43%	64%	47%			

Exhibit 5-6

Mechanical Wringing Efficiencies (%), 2.0 X							
	Kimwipes	Workhorse	Kimtex	Reusables	mean	1 std. dev.	
Acetone	39.83	19.73	32.41	15.93	27.0	9.6	36%
MEK	29.23	13.57	30.51	11.49	21.2	8.7	41%
VM&P Naphtha	32.76	5.63	33.70	26.05	24.5	11.3	46%
3-part mixture	25.44	14.47	23.87	23.00	21.7	4.3	20%
Isopropanol	39.78	14.20	25.42	26.71	26.5	9.1	34%
CH2Cl2	14.97	9.74	14.77	10.94	12.6	2.3	18%
mean	30.3	12.9	26.8	19.0			
1 std. dev.	8.6	4.4	6.4	6.5			
	28%	34%	24%	34%			

Exhibit 5-7
Comparison of Solvent-Removal Efficiencies
Disposable Paper and Reusable Shop Towels

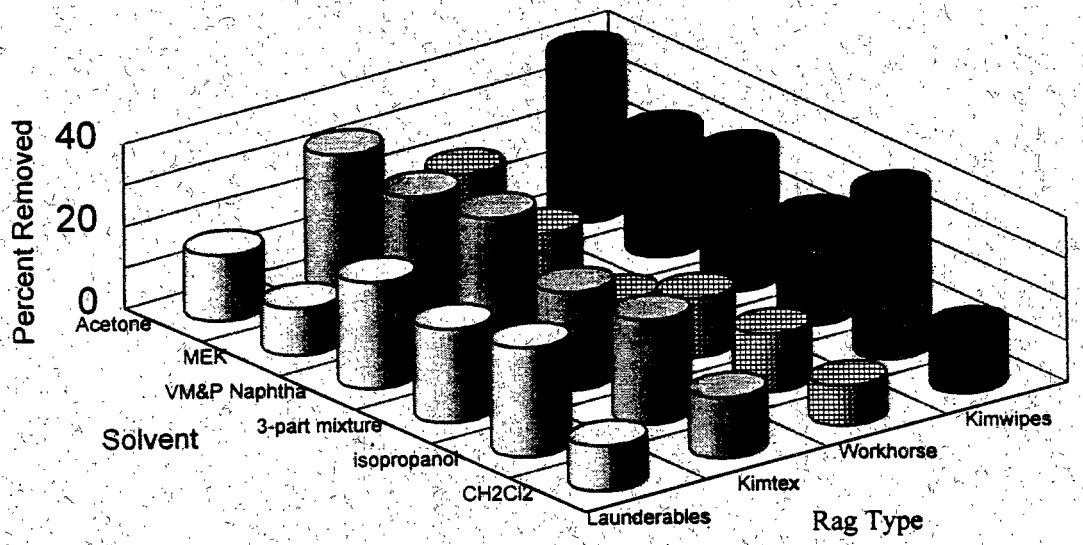


Exhibit 5-8
Disposable Cloth Wipers, Mechanical Wringing, % of Solvent 2 Times Weight of Wiper

Solvent/Type of Disposable Cloth	Knit	Flannel	Table Linen	Towel	Broadcloth	Fleece
Acetone	19.61; 25.85	34.20				
MEK	35.16		30.57; 34.04			
VM&P Naphtha	35.94; 55.80	42.19				
3 Component Mix[2]	27.76; 35.14			10.80		
IPA	28.49; 33.09		25.40			
Methylene Chloride	14.91				26.60	33.80

[2]20% VM&P Naphtha; 50% IPA, 30% MEK

5.3 Centrifugation

Centrifugation removal efficiency data were generated during a site visit to a printing facility. Additional centrifugation data were provided by a flexo printer that was observed during our scoping study. These later data are provided in Appendix I.

Exhibits 5-9 and 5-10 provide the extraction efficiency results for the centrifugation experiments (see trip report WG-1, Appendix A). At this facility, shop towels were weighed immediately before and after centrifugation. The facility uses the centrifugation unit to extract solvents from shop rags prior to laundering. Using the average shop towel weights, we calculated removal efficiencies of 47% and 53%. Note in Exhibit 5-9 that the shop towel weight after centrifuging actually increased in two instances. We believe this phenomena results from shop towels picking up solvent from wetter towels during the centrifuging process.

Data provided by John Roberts estimated a removal efficiency of 87%. Differences in the two experiments may be due to wiper characteristics (the base weight suggests that the wipers are extremely different), and the fact that one data set (WG1-1) is based on rags that included ink contaminants and the other set is based on rags that were contaminated with solvent only. (Concern also was expressed by the centrifuge operator at the site visit that suggested the centrifuge was not operating efficiently -- based on previous removal efficiency data generated.)

Exhibit 5-9 Centrifugation Extraction Efficiency	
Average Weight of Unused Rag: 41.2 grams	
Weight Before Centrifuging (grams)	**Weight After Centrifuging (grams)**
94.1	64.1
93.0	59.2
96.8	61.6
52.9	74.9
67.7	63.2
86.7	58.7
80.3	79.8
91.8	58.5
103.5	52.8
92.4	58.5
104.7	54.8
71.5	60.8
96.0	51.9
66.5	54.1
95.2	76.1
117.6	63.9
77.8	72.9
67.6	70.2
91.9	67.8
97.0	56.2
108.9	63.4
90.7	70.1
75.5	70.1
84.9	64.8
Average Weight: 88.6(g)	**Average Weight: 63.7(g)**
Removal Efficiency: 47%	

Exhibit 5-10 Centrifugation Extraction Efficiency	
Average Weight of Unused Rag: 41.2 grams	
Weight Before Centrifuging (grams)	**Weight After Centrifuging (grams)**
106.1	67.4
94.8	61.9
93.7	80.9
115.3	58
91.7	71.2
110.2	67.1
108.1	60.4
83.7	66.2
101.2	74.4
93.0	71.8
94.3	64.4
97.5	63.5
97.6	74.0
99.6	65.8
92.7	73.5
99.8	66.2
103.7	80.5
104.6	65.7
100.1	65.8
90.6	54.2
97.3	56.1
90.9	75.7
98.0	63.9
86.8	72.2
106.7	63.5
Average Weight: 92.0(g)	**Average Weight: 68.0(g)**
Removal Efficiency: 53%	

5.4 Air Drying

Evaluation of the efficiency of high-volume air drying as a removal technology is realistic only if one assumes that the technology is or will become available to capture the extracted solvent on a charcoal filter or other device. Otherwise, air drying is a clear-cut source of fugitive emissions, and not appropriate for use as a removal technology. Given the assumption that the technology may be relevant under certain scenarios, evaluation of air drying was conducted utilizing the disposable cloth wipers left over from the hand- and mechanical-wringing experiments.

Wipers were left in the back of the lab hood, and re-weighed at the end of the day. The wipers were not spread out, rather, they were piled haphazardly. The hoods have high velocity air transport, and no effort was made to control temperature, air flow, or wiper exposure. The weight of solvent removed was calculated by difference, using the weights obtained after wringing as the starting weight. The removal efficiency was calculated:

removal efficiency = (wt of solvent removed/wt of solvent at start) X 100

wt of solvent removed = wt after wringing - wt after air drying
wt of solvent at start = wt after wringing - base wt of wiper.

Exhibit 5-11 presents a summary of the removal efficiencies calculated. All of the raw data generated in the air drying experiments are contained in Appendix J. High-volume air drying has a removal efficiency of nearly 100%, regardless of wiper type or solvent.

Exhibit 5-11
Air Drying Efficiencies

	Kimwipes	Workhorse	Kimtex	Launderable	Disp.Cloth	mean	1 std. dev.	
Acetone	100.48	99.8	100.1	100.6	99.0	100.0	0.6	1%
MEK	98.09	99.4	101.7	100.8	98.3	99.7	1.4	1%
VM&P Naphtha	99.53	100.7	99.9	97.8	99.9	99.6	0.9	1%
mean	99.4	100.0	100.6	99.8	198.8			
1 std. dev.	1.0	0.5	0.8	1.4	0.6			
	1%	1%	1%	1%	0%			

5.5 Screen-Bottom Drums

Laboratory experiments in a screen bottom container were conducted to both understand the removal efficiencies of this technology and also to understand the effects of percolation in solvent-contaminated shop towels and wipers. During the laboratory phase of the project, screen-bottom drums were constructed from 30-gallon steel drums and stiff aluminum hardware cloth, using the drum observed during the site visits as a model. The hardware cloth was cut and formed into a raised floor inside the drums, at a level equivalent to about 50% of the drum volume.

An experiment designed to evaluate the efficiency of the screen-bottom drum as a removal technology, and to understand the effects of percolation, was conducted by packing drums with wipers contaminated with an amount of solvent equivalent to twice the weight of the wiper. To maximize the number of wipers that could be tested, more than one wiper type was packed in a drum. Wiper types were separated by barriers made of stiff aluminum hardware cloth. Experiments were conducted using VM&P Naphtha and Acetone, two commonly used solvents of widely differing volatility and chemical functionality. Only one solvent was tested per drum. Wipers were reweighed approximately 24 hours after they were packed into the drum, in order from top to bottom of the pile. The resulting data were examined for any apparent gradient of wiper weight (due to solvent migration). The volume of residual solvent below the screen bottom was weighed.

Exhibit 5-12 presents a summary of the data for one wiper type (Kimtex) in a single experiment (Acetone), and Exhibit 5-13 provides a graphical depiction of the weight gradient from the top to bottom of the pile for this one wiper type in this experiment. The weight gradient seen in this experiment and other screen bottom drum experiments is significant (the line described by the data points has an increasing slope and a regression coefficient of 1.0, indicating that there is a linear increase in wiper weight as you proceed down through the pile).

The results of the experiments for the other shop towel/wiper types in conjunction with acetone are presented in Exhibit 5-14. Again, similar trends in the amount of solvent on these shop towels/wipers increases from top to bottom. Exhibit 5-15 presents similar results for all wiper types in conjunction with the VM&P Naphtha experiment.

From these experiments, approximately 100 ml of acetone was measured below the screen-bottom for the experiment using acetone. Since we know how much acetone in total was added to the wipers in this experiment (2,416 ml), a removal efficiency of 4%was calculated for this experiment. Using the same procedure for VM&P Naphtha , a removal efficiency of 28% was calculated (2,618 ml of solvent added to the drum, 750 ml collected in the bottom of the drum). The difference in volumes of residual solvents may be attributable to the differences in volatility of the two solvents.

Within the context of this experiment, these data indicate that the removal efficiency of a

Exhibit 5-12
Screen Bottom Drum Experiment
Kimtex, Acetone

weight, top to bottom w/ solvent (g)	weight of solvent (g)
28.5	21.08
26.8	19.38
29.3	21.88
28.9	21.48
30	22.58
29.3	21.88
26.5	19.08
27.5	20.08
29.8	22.38
30.8	23.38
30.2	22.78
27.8	20.38
31.3	23.88
28.9	21.48
30.8	23.38
31.7	24.28
28.5	21.08
31.1	23.68

Exhibit 5-13

Kimtex with Acetone Screen Bottom
Drum Experiment

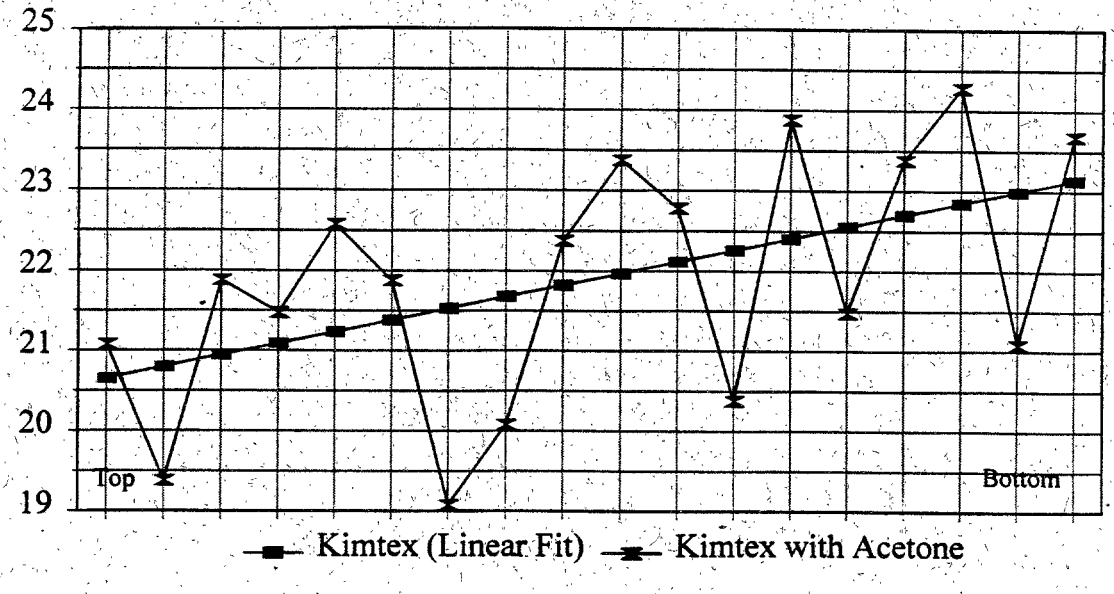


Exhibit 5-14
Screen Bottom Drum, Acetone
Wiper Weight, Top to Bottom of Drum (g)

Reusables	Workhorse	Kimwipes	Disposable Cloth	
47	20.3	3	wt. before	wt. after
56.8	22.8	3	26.9	54.4
62.7	20.1	3.6	38.4	59.5
60.5	20.8	3.9	49.4	80
57.8	23.7	3.4		
63	25.5	3.7		
60.7	25.8	4		
55.7	27.1	4		
54.6	27.1	4.2		
57		4		
58.4				
61.4				
68.7				
58.8				
63.6				

Exhibit 5-15
Screen Bottom Drum, VM&P Naphtha
Wiper Weight, Top to Bottom of Drum

Kimtex	Reusables	Workhorse	Kimwipes	Disposable Cloth	
28.4	59.6	25.2	3.8	wt. before	wt. after
31.2	64.3	28	3.9	31.2	54.5
27.1	59.7	25.4	4	36.9	67.4
25	55.6	27.8	4	60.9	110.1
26.1	55.2	28	4.4		
36	60.7	29.7	4.2		
30.7	56.2	35	4.4		
33.2	53.4	32	4.1		
27.8	58.4		5.2		
	60.3		6.9		
	56.6		4.5		

screen-bottom in a closed container is inconsistent, and may not be a particularly efficient removal technology in some cases. Further experiments are probably necessary.

5.6 Conclusions on Removal Efficiency

From these data on removal efficiencies, we can conclude that release characteristics vary widely between wiper types. Solvents are extracted differently relative to other solvents within a given wiper type. This difference is not as dramatic or significant as the differences between wiper types. Also:

- High-volume air drying is very efficient at removing solvents from wipers (efficiencies near 100%), assuming a control device such as a carbon canister is attached. However, inexpensive commercial options for collection of the solvent removed does not appear readily available (although research into this area did not occur). Therefore, air-drying as a removal technology probably may have limited application.

- Centrifugation is a very efficient solvent removal technology, with efficiencies ranging from 47% to 87%, and is commercially available both as equipment purchase and contract service.

- Mechanical wringing is more efficient at removing solvent from wipers than hand wringing. At 2 times the weight of the wiper, mechanical wringing efficiencies range from 13% to 30% for disposable paper wipers, 19% for reusables, and from 10.8% to 56% for disposable cloth wipers. Hand wringing, at 2 times the weight of the wiper, ranges from 4.6% to 23.9% for disposable paper, 11.3% for reusables, and 1.5% to 68% for disposable cloth wipers.

- Screen bottom drums do not appear to be very efficient passive removal technologies (efficiencies range from 4% to 28%), but further experiments may be necessary. The efficiency appears to be dependent on the solvent being used, and may also depend on the type of wiper. This technology may be more useful if used in conjunction with mechanical wringing or hand wringing, but not alone.

6. Next Steps

This chapter discusses the next steps we intend to undertake to address and resolve the long standing issue of solvent-contaminated shop towels and wipers. These steps are based on the results of our data collection efforts.

There are three major findings from our data collection effort. First, there is tremendous variability in use and management practices of solvent contaminated shop towels and wipers by industry. Second, some facilities are using small amounts of solvent on both disposable wipers and reusable shop towels, and also using small numbers of these materials on a daily basis. The result may be that these currently regulated materials **may** not pose a risk to human health and the environment, particularly in the case of disposable wipers sent to a municipal landfill. However, we do not have an estimate of the number of these facilities, but believe they are considerable given the thousands of facilities using solvent-contaminated shop towels and wipers.

Third, an undetermined number of facilities **may** not be complying with either federal or State rules and policies associated with solvent-contaminated shop towels and wipers. Hazardous disposable wipers are sometimes being managed in municipal landfills when they should be managed as hazardous wastes, and reusable shop towels are sometimes being transported with hazardous "free liquids" to industrial laundries violating the key condition for the hazardous waste exemption that many States have granted both generating facilities and industrial laundries. For both types of materials, we do not know the potential extent of this non-compliance.

Additional data are desirable to (1) identify those solvent-removal technologies, particularly at the low efficiency end, to assist generators in ensuring "free liquids" are not sent off-site to an industrial laundry, and (2) to determine under what conditions, if any, a container with "no free liquids" could possible self-ignite.

Therefore, before moving forward with recommending any policy changes to the current regulatory framework, we believe it important to respond to the above data gaps by:

1. Conducting a risk-screening analyses with the use of currently available multi-media risk assessment models to identify those situations (i.e., solvent-type, quantity of solvent and type of wiper), if any, under which the disposal of solvent-contaminated wipers does not pose a risk to human health and the environment.

2. Conducting additional experiments for combinations of low-end solvent-removal technologies; i.e. hand wringing or mechanical wringing in conjunction with screen-bottom drums to further understand situations under which "free liquids" occur in the bottom of containers.

3. Conducting experiments to identify possible situations, if any, under which solvent-contaminated shop towels and wipers containing "no free liquids" could still self-ignite.

We expect to complete these tasks by March of 1998 and to follow that with consideration of proposed policy and/or regulatory changes.

Similarly, any policy changes proposed will strive to respond to the concerns of our various stakeholders. These concerns include:

-- any rule change or policy change must be easy to understand and be practicable
-- flexibility is provided in how to achieve compliance
-- minimal, if any, increase in compliance costs; if possible, decreases in compliance cost
-- enhanced environmental protection
-- encourage and foster use of pollution prevention
-- reduce barriers to safe hazardous waste recycling

The first factor is probably the most important because users of solvent-contaminated shop towels and wipers most often are small businesses where the owner/operator is also responsible for implementing and complying with all applicable environmental regulations. He or she does not have the time or resources to investigate ways of implementing a new environmental regulation. Instead, (1) they want to understand the need for imposition of an environmental regulation, and (2) they need easy to use tools that they can readily understand and implement--some would even argue for no more than a one-page description of what they need to do.

A factor equally important to the regulated or potentially regulated parties is compliance cost. Ideally, the regulated community would like to see any new regulation imposed upon them either reduce compliance cost, or least maintain the status quo in terms of no additional compliance cost. Similarly, any increase in compliance cost, if necessary, should be held to a minimum by providing flexibility in how compliance shall be achieved.

We have identified potential situations where the regulation of disposable wipers might be too stringent, and also identified situations where hazardous disposable wipers are being sent to a municipal landfill when they should be managed as a hazardous waste according to current State policies. We also have identified potential situations where the management of reusable shop towels might be unsafe; i.e free liquids from reusable wipers being sent off-site to an industrial laundry. Any potential solution should strive to address these potential problems.

This problem originates with chemicals in solvents that can adversely affect human health and the environment when mismanaged. Therefore, fostering pollution prevention incentives through management behavioral changes, such as shifts to non-hazardous (non-toxic and non-ignitable) solvents or reductions in the amount of solvent used, can eliminate or significantly reduce this problem entirely, or if not significantly. Similarly, if pollution prevention practices

cannot be implemented, removing and recycling the spent solvent from the shop towel or wiper is much better environmentally (and probably economically) than treating or disposing of the solvent.